



## ARTHROPOD PESTS AND THEIR NATURAL ENEMIES ASSOCIATED WITH COTTON IN INDIA: A REVIEW

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### ABSTRACT

Globally cotton is the most important natural fibre crop being cultivated commercially for domestic textile needs and export. Cotton plays an important role in India's economy, occupies largest acreage and highest production in the world. In India, cotton is being grown in 10 major states divided in 3 distinct zones viz., north, central and south with varying climate and soil. Despite large acreage, cotton productivity in India is far below world average due to variety of reasons. Among them damage caused due to arthropod pests is vital. In this article authors have attempted through extensive literature survey, to provide up to date information on arthropod pests and their natural enemies associated with cotton crop in India. It is observed that, in India, cotton crop is attacked by 251 arthropod pest species (including insect and mites) belonging to 9 insect orders and 1 order from Acarina. Among these, about 12 species of insects are major pests causing significant losses to cotton crop while remaining species are either occasional, sporadic or minor in nature. Overall these pests cause economic damage to cotton crop in a range between 20-60 per cent. The major arthropod pests are sucking insects namely leafhopper *Amsasca biguttula biguttula* (Ishida), aphid *Aphis gossypii* Glover, thrips *Thrips tabaci* Lindeman., whitefly *Bemisia tabaci* (Gennadius), Cotton mealybug *Phenacoccus solenopsis* Tinsley, Papaya mealybug *Paracoccus marginatus* Williams and Granara de Willink, and Indian cotton mirid bug *Creontiades biseratense* (Distant). The bollworm complex is another major group of insects that attack cotton and comprises of American bollworm *Helicoverpa armigera* (Hubner), spotted bollworms *Earias insulana* (Boisduval), *E. vitella* (F.) and pink bollworm *Pectinophora gossypiella* (Saunders). Other pests like stem weevil *Pempherulus affinis* Faust and tobacco caterpillar *Spodoptera litura* F., are also categorized as major pests. A rich fauna of 368 natural enemies (including 174 species of predators and 194 species of parasitoids/ parasites) play significant role as biological control agents to check arthropod pests in cotton ecosystems of India. In this review there is addition of 85 arthropod pests over previously reported 166 arthropod pests. This updated information on cotton pests and their important natural enemies may serve as an important guide to researchers and policy makers in carrying out potential pest risk assessment and devising appropriate management strategies for economically damaging cotton pests.

**Key words:** Cotton, India, cotton ecosystem, arthropod pests, fauna, insects, mites, sucking pests, bollworms, resurgence, natural enemies, predators, parasitoids

Cotton is the most important natural fibre crop cultivated commercially for domestic textile needs as well as export. Cotton plays a major role in India's economy, both in terms of providing employment directly and indirectly to more than 60 million people. India occupy largest cotton acreage (13.373 m ha) and production (36.5 m bales, 1 bale=170 kg) in the world (CICR, 2020). India is the only country where all the four cultivated species of cotton viz., *Gossypium hirsutum* Linn., *G. barbadense* Linn., *G. arboreum* Linn., and *G. herbaceum* Linn. being grown for lint, oil and feed. In India, cotton is being cultivated in 10 major states classified into 3 distinct zones viz., north zone comprising of Punjab, Haryana and Rajasthan; central

zone comprising of Madhya Pradesh, Maharashtra and Gujarat, and south zone comprising of Andhra Pradesh, Telangana, Karnataka and Tamil Nadu. These three zones have distinct bio geographical features with varying climate and soil. Though, India shares largest area under cotton, however Indian cotton productivity is lowest (464 kg lint/ ha) due to variety of reasons, among them damage due to various arthropod pests is one of the major yield limiting factors.

Previous records revealed, worldwide, cotton crop is attacked by 1326 species of arthropod pests (Hargreaves, 1948). In India, initial records indicated 109 species of insects and mites infest the cotton crop

(Nangpal, 1948). Later, this number increased to a total of 166 species (Khan and Rao, 1960). These pests were reported attacking cotton crop at different stages of growth causing losses ranging between 50-60% (Puri et al., 1999). There is gap of almost 60 years since 1960 (Khan and Rao 1960) on the updating of arthropod associated with cotton in India. Since then updated information on new records of pests on cotton is seriously lacking. The major insect pests documented in above reports include: i. Bollworm complex comprising of American bollworm *Helicoverpa armigera* (Hubner), spotted bollworms *Earias insulana* (Boisduval), *E. vittella* (F.) and pink bollworm *Pectinophora gossypiella* (Saunders); and ii. Sucking pest complex consisting of leafhopper (*Amrasca biguttula biguttula* Ishida), aphids (*Aphis gossypii* Glover), thrips (*Thrips tabaci* Lindeman) and whitefly (*Bemesia tabaci* Gennadius). With the introduction of genetically modified cotton, popularly known as 'Bt cotton' in 2002 for bollworm control, Indian cotton ecosystem experienced a phenomenal change in its pest profile. There have been frequent pest resurgences of already existing pests as well as few recent invasions which were hitherto not reported to be the pests of cotton. In this review, an attempt has been made through an extensive review of literature to provide an up-to-date information on pest fauna associated with cotton in India. Additionally, a comprehensive list of diverse natural enemy complex including both predators and parasitoids that are prevalent in Indian cotton ecosystem have been provided as a ready reckoner for researchers, extension workers and policy makers in assessing the potential pest risks and formulating effective management strategies for various insect pests in cotton.

### Arthropod pests

The information updated through extensive literature survey revealed that the number of pests (including insects and mites) attacking cotton crop in India has been increased to 251 from earlier report of 166 species (Table 1). These 251 species documented here belonged to 9 different insect orders and one order from Acarina. The reported insect pest species attacking cotton crop have been categorised broadly in two groups; one group included sucking pests and another group included chewing, biting and borer insects. Among sucking pests, insect order Hemiptera contributed 72 species belonging to 18 families viz., Aleyrodidae (1), Aphididae (2), Capsidae (3), Cercopidae (2), Cerococcidae (1), Cicadellidae (8), Coccidae (3), Coreidae (8), Diaspididae (1), Eurybrachidae (1), Fulgoridae (2), Lygaeidae (8), Membracidae (2), Miridae (9),

Monophlebidae (1), Pentatomidae (5), Pseudococcidae (11) and Pyrrhocoridae (4). It was followed by 4 species of Thysanoptera belonging to a single family Thripidae. Among chewing, biting and borers insects; insect order Coleoptera contributed 41 species from 11 families which comprised of Anthribidae (1), Bostrichidae (1), Bruchidae (1), Buprestidae (1), Cerambycidae (1), Curculionidae (25), Chrysomelidae (2), Galeracidae (1), Meloidae (4), Scarabaeidae (2), Tenebrionidae (2); order Lepidoptera contributed 60 species from 12 different families Arctiidae (6), Cassidae (1), Cosmopterigidae (1), Crambidae (2), Erebidae (2), Gelechiidae (1), Lymantriidae (5), Lyonetiidae (1), Noctuidae (35), Oracilariidae (1), Pyralidae (3), Tineidae (2); order Orthoptera included 33 species from 05 families viz., Acridiidae (20), Gryllaeridae (1), Gryllidae (10), Pyrogomorphidae (1), Tettigoniidae (1); order Hymenoptera comprised of 9 species from single family Formicidae while order Isoptera had 6 species from family Termitidae. Order Diptera contributed 5 species from four families Agromyzidae (1), Cecidomyiidae (1), Chloropidae (1) and Sarcophagidae (2). The order Dermaptera contributed only 3 species from families Anisolabididae (2) and Forficulidae (1) (Table 1). In mite pests, the only Order Acarina of mites contributed 18 species from six different families viz., Eriophyidae (3), Erythraeidae (1), Phytoseiidae (2), Tarsonemidae (1), Tenuipalpidae (1) and Tetranychidae (10) (Table 1). Over the previously reported 166 arthropod pest species (Khan and Rao 1960) there is addition of 85 arthropod pests in this review.

Among the 251 arthropods species, 12 species of insects are major pests causing significant losses to cotton crop while remaining species are occasional, sporadic or minor in nature. The sucking insect pests (leafhopper, aphid, thrips, whitefly, cotton mealybug, papaya mealybug and Indian cotton mirid bug), the bollworm complex (American bollworm, spotted bollworms and pink bollworm) and the other pests like stem weevil *Pempherulus affinis* Faust and tobacco caterpillar *Spodoptera litura* Fabricius are the major pests of cotton in India. These arthropod pests cause yield losses ranging from 20-60 %. Current status of these pests is given in later part of this article. The relative proportion of insect species from different orders is presented in Fig. 1.

### Natural enemies

Interestingly, a rich fauna of 368 natural enemies have been recorded on various insect pests of cotton from different cotton growing zones of India (Table 2

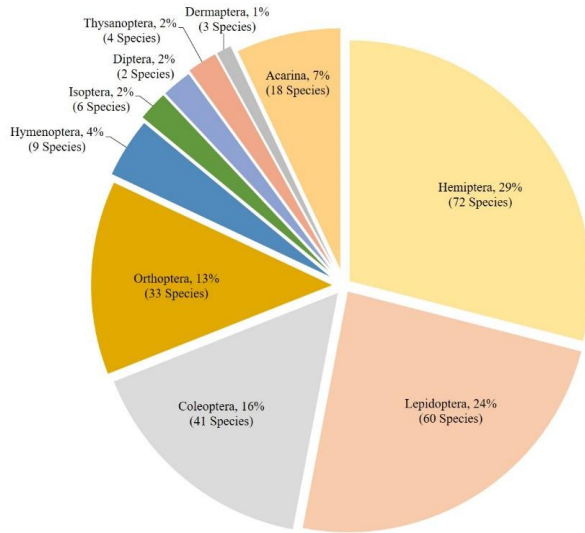


Fig. 1. Number of arthropod species and its relative proportion from ten different orders recorded on cotton ecosystems of India

and 3). These natural enemies are key component of cotton ecosystem and are playing a vital role in natural suppression of insect pests therein. Thus, looking at the vast diversity of predators and parasitic fauna associated with pests of cotton ecosystem, there is a great potential for implementation of environment friendly biological control of cotton insect pests.

### Predators

The predatory fauna appetizing on various cotton insect pests comprised of 174 species (Table 2). Predators from insect order Coleoptera contributed 23 species mainly from Coccinellidae (22) and Staphylinidae (1); order Neuroptera contributed 9 species from Crysopidae (8) and Hemerobidae (1); order Diptera contributed 14 species from Asilidae (1), Cecidomyiidae (1), Chamaemyiidae (3), Drosophilidae (1) and Syrphidae (8); order Hemiptera contributed 20 species from families Anthocoridae (4), Geocoridae (4), Miridae (2), Pentatomidae (1), Pyrrhocoridae (1), Reduviidae (8); order Lepidoptera contributed 3 species from Lycaenidae (1), Noctuidae (2); Mantodea contributed 3 species from Mantidea; order Hymenoptera contributed 16 species from Aphelinidae (1), Formicidae (3), Scoliidae (1), Sphecidae (8), Vespidae (3); order Odonata contributed 4 species from Libellulidae (4); Araneae contributed 76 species (44.25%) from Araneidae (11), Clubionidae (2), Dictynidae (1), Eutichuridae (1), Gnaphosidae (1), Lycosidae (6), Oxyopidae (19), Parassidae (1), Pisauridae (1), Salticidae (14), Sparassidae (1), Tetragnathidae (5), Theridiidae (3), Thomisidae (9), Uloboridae (1); Mite order Acarina contributed 5 species of predatory mites

from two families Phytoseiidae (4) and Pyemotidae (1). The relative proportion of predatory species from different orders is presented in Fig. 2.

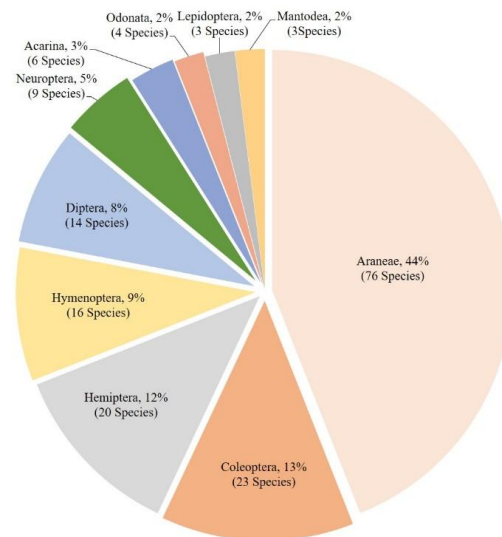


Fig. 2. Number of predatory arthropod species and its relative proportion (%) from ten different orders recorded in cotton ecosystems of India

### Parasitoids/ Parasite

There are total 194 different species of parasitoids associated with insect pests of cotton ecosystems in India (Table 3). The Hymenoptera, a single insect order contributed 163 species which accounts for about 83.85% of the total parasitic fauna. The Hymenopteran parasitic families included Aphelinidae (13), Braconidae (53), Chalcidae (21), Elasmidae (5), Encyrtidae (31), Eulophidae (9), Eurytomidae (1), Ichneumonidae (14), Mymaridae (2), Pteromalidae (3), Scelionidae (2), Thysanidae (1) and Trichogrammatidae (8) (Fig. 3).

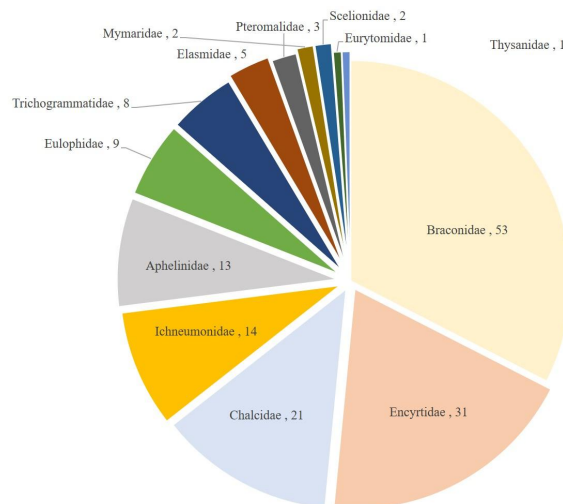


Fig. 3. Distribution of number of species in each family of order Hymenoptera

Another insect order Diptera contributed remaining 30 species (15.63%) from two families Chloropidae (1) and Tachinidae (29). Only one parasite from Acarina belonging to family Pyemotidae has been reported (Table 3). The relative proportion of parasitoid species from different orders is presented in Fig. 4.

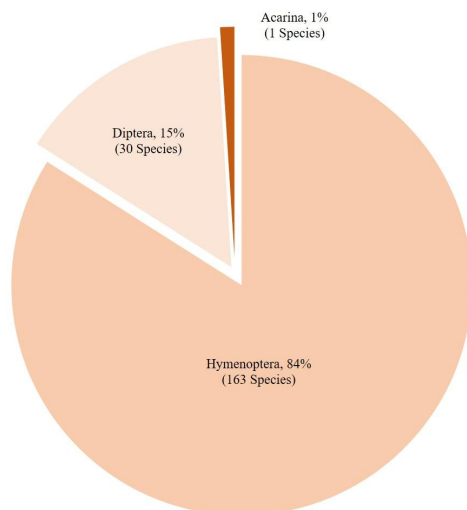


Fig. 4. Number of parasitoids species and their relative proportion from three orders recorded in cotton ecosystems of India

## Present status of major pests

### Sucking insects

#### 1. Leafhopper *Amrasca biguttula biguttula* (Ishida)

Leafhopper *Amrasca biguttula biguttula* (Ishida) is one of the most important pests of cotton in India (Pruthi, 1940; Husain, 1937; Shivanna et al., 2009; Murugesan and Kavitha, 2010). Leafhopper is a major and regular pest feed on the sap of mesophyll and vascular tissues through cell rupture and cause phytotoxic symptoms known as causes 'hopperburn' consequently leading to reduction in crop vitality and cotton yield loss up to 30%. The pest is distributed in all the three cotton growing zones and is a regular pest. It is a polyphagous insect pest of Asia and Southeast Asian countries. Genetic divergence analysis of leafhopper population across India confirmed the presence of single species. North India populations were dominated by single haplotype while, the south and central Indian populations show dispersion of different haplotypes across the region (Kranthi et al., 2017).

#### 2. Aphid *Aphis gossypii* Glover

Aphid has been reported as a major pest of cotton causing significant damage to the cotton crop. This species has been reported as a vector of Pulerovirus

infecting cotton in India (Mukherjee et al., 2012). Nagrare et al. (2019) studied the temperature effects on phenology of *A. gossypii* and reported that temperatures between 22 - 27°C favoured its optimum development. Further, they estimated through fitting of non-linear models to temperature dependent development data, the lower and upper thresholds temperatures of 6.24°C and 34°C, respectively for *A. gossypii* development.

#### 3. Thrips *Thrips tabaci* Lindeman

Thrips lacerate the tissue and de-sap the plants from the upper and lower surfaces of leaves, resulting in silvery or brown necrotic spots. Infested plants demonstrate hampered growth, loss of vigor. Leaves turned into wrinkled and distorted, curl upward with white shiny patches, resulting in dropping of squares, delayed crop maturity and reduction in yield. Tobacco streak virus disease transmitted by *T. tabaci* has been recorded in central and south zone of India (Bhat et al., 2002; Jagtap et al., 2012).

#### 4. Whitefly *Bemisia tabaci* (Gennadius)

Whitefly is a major pest occurring in all the three cotton growing zones of India, but it is the most important sucking pest in North Indian cotton growing states of Punjab, Haryana and Rajasthan by virtue of its capability to transmit cotton leaf curl virus disease (CLCuD), especially in *hirsutum* cotton. Several outbreaks of whitefly were reported in India (Basu, 1986; Jayaraj et al., 1986) but the recent one was witnessed during 2015 in north India (Kranthi, 2015b). *Bemisia tabaci* is a vector of begomoviruses (family *Geminiviridae*). *Bemisia tabaci* is reported to transmit 111 viruses (Tiwari et al., 2013). Whitefly causes direct damage by sucking phloem sap from plant tissues, while indirect damage through the excretion of sticky honeydew which promotes a fungal sooty mould that interfere in photosynthesis in leaves and deteriorate the quality of cotton.

#### 5. Cotton mealybug *Phenacoccus solenopsis* Tinsley

Widespread outbreak of invasive species of mealybug occurred on cotton in India during 2007 which caused economic damage, thereby reducing yields up to 50% in affected cotton fields (Nagrare et al., 2009). The infestation was recorded in nine major cotton growing states of India. Infestation of cotton mealybug at most of the places in north and central zones was high during 2007 and 2008 but it was reduced to a minor pest from 2009 onwards. *Phenacoccus solenopsis* suck sap from all parts of the plant, resulting stem distortion,



twisting and bushiness of the affected portion and death of plant in severe infestation. Since its invasion in India, *P. solenopsis* is the most extensively studied insect pest of cotton so far with respect to various aspects like host range and infestations levels (Tanwar et al., 2007; Jhala et al., 2008; Nagrare et al., 2009; Fand et al., 2010; Venilla et al., 2011), important biological control agents including predators and parasitoids (Tanwar et al., 2008; Rishi et al., 2009; Fand et al., 2010b, c; Fand et al., 2011; Suroshe et al., 2013) and potential geographic distribution, temperature dependent biology, within plant distribution (Rishi et al., 2013) and climate change impact on future invasiveness (Fand et al., 2014a, b, c). A detailed account of this mealybug with a major focus on its origin and distribution, biosystematics, bioecology, host range, management options and its potential threat under future climate change has been reviewed by Fand and Suroshe (2015).

#### 6. Papaya mealybug *Paracoccus marginatus* Williams and Granara de Willink

Papaya mealybug was recorded in a severe form for the first time on cotton in Coimbatore in 2008-09, infestation leads to drying of the sympodial branches (Dhara Jothi et al., 2009). The mealybug also found in other districts like Erode, Tirupur, Salem, Namakkal and Karur districts of Tamil Nadu (Tanwar et al., 2010). The pest is now seen in traces.

#### 7. Indian cotton mirid bug *Creontiades biseratense* (Distant)

Infestation of Indian cotton mirid bug was observed in Karnataka (Patil et al., 2006). An epidemic form in Coimbatore on cotton during 2006 (Surulivelu and Dhara Jothi, 2007) led to significant reduction in seed cotton yield of Bt cotton. The pest feeds on the flower bud result in oozing out of yellow fluid from the buds and staining of this yellow fluid on the inner surface of the bracts. Cotton mirid bug is a major pest restricted to Tamil Nadu and Karnataka states of South Zone.

### Cotton bollworms

#### 8. American bollworm *Helicoverpa armigera* (Hubner)

It is considered as a major and most notorious and obnoxious pest of cotton in Indian sub-continent. Heavy infestation of American bollworm witnessed during 1995-2000 in view of the injudicious use of insecticides, especially synthetic pyrethroids that led to problems of insecticide resistance. Subsequently, after 2000, with the introduction new technologies like Bt-cotton, new chemistry insecticide, etc. (Kranthi and Russell, 2009),

*H. armigera* infestation reduced significantly and in the last two decade it hardly ever exceeded economic threshold levels in majority of the cotton growing regions on Bt cotton of India. However, infestation of *H. armigera* observed on non-Bt cotton. The pest feed on squares/ bolls and results in yield loss up to 40% in non-Bt cotton.

#### 9. Spotted bollworms *Earias insulana* (Boisduvel)

Spotted bollworm *Earias vittella* (Fabricius) and spiny bollworm *E. insulana* (Boisduvel), (Lepidoptera: Noctuidae) are the major pests of cotton in India. *Earias vittella* is seen in Central and South India while *E. insulana* is predominant species in North India. At present both these species are under control on Bt cotton (Rishi et al., 2019). Larvae of the pests initially bore into terminal shoot that dry and wither away when the larvae bore into the pre-squaring plants. As like *H. armigera*, *Earias* spp hardly exceeded economic threshold level on Bt cotton, however, seen to damage non Bt cotton.

#### 10. Pink bollworm *Pectinophora gossypiella* (Saunders)

Pink bollworm *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae) is destructive pest of cotton in India. Larvae mainly feed on developing cotton seeds. Quality of lint deteriorated due to the presence of larvae and lint get stained by the pest. Up to 61.9 per cent loss in seed cotton yield, 47.10 per cent loss in oil content and 59.20 per cent loss in normal opening of bolls was reported (Patil, 2003). Presently, Bt technology is unable to protect cotton crop from *P. gossypiella* due to development of resistance against Cry1Ac and Cry 2Ab toxins in India. Widespread infestation of pink bollworm on Bt cotton was reported from major cotton growing Indian states like Gujarat, Maharashtra, Andhra Pradesh, Telangana, Karnataka and Madhya Pradesh starting from 2015 onwards (Kranthi, 2015; Naik et al., 2018, 2020, Fand et al., 2019). The pest also seen infesting Bt cotton during 2018-2019 and 2019-2020 in north zone especially in Jind district of Haryana (Rishi et al., 2020).

### Other insects

#### 11. Tobacco caterpillar *Spodoptera litura* Fabricius

During eighties to late nineties, Tobacco caterpillar, *Spodoptera litura* Fabricius (Lepidoptera: Noctuidae) was one of the economically important polyphagous pests of cotton which exhibited high resistance levels when pyrethroids were first introduced in India in 1982 (Ramakrishnan et al., 1984; Kranthi et al., 2002). The

pest was severe in most parts of Andhra Pradesh (Armes et al., 1997).

## 12. Stem Weevil *Pempherulus affinis* Faust

Stem weevil *Pempherulus affinis* Faust (Coleoptera: Curculionidae), is an endemic pest in some parts of south India, particularly Tamil Nadu, causes 65.8% plant mortality, 72.0% reduction in boll production and 78.9% reduction in yield of seed cotton (Parameswaran and Chelliah 1984). Grub tunnel the stem which damages the vascular tissues. Infested plant gets killed in the course of time either due to blockage of plant nutrients or break down at the gall region due to strong winds. The pest is mostly prevalent in irrigated tracks.

## CONCLUSIONS

Over the period of time, Indian cotton ecosystem has witnessed a sea change in its cultivation practices and pest profile. In the context of climate change and introduction of Bt cotton for commercial cultivation, the cotton crop has experienced very frequent invasions of some new insect pests as well as resurgence of already existing insect pest. There is gap of almost 60 years since 1960 on the updating of arthropods associated with cotton in India. Our efforts to provide an updated list of insect pests and natural enemy fauna associated with cotton brought to the forefront an important information that presently the cotton crop in India is attacked by 251 arthropod pest species (including insect and mites) belonging to 9 different insect orders and 1 acarina. Among these species, about 12 species of insects are major pests during last two decades causing overall losses to the tune of 20-60% to cotton crop while remaining species are occasional, sporadic or minor in nature. A rich fauna of 368 natural enemies (174 predators and 194 parasitoids/ parasites) found to play a significant role in regulation of arthropod pests of cotton in India, indicating a great potential for conservation and promotion of eco-friendly biological control in cotton ecosystem.

## ACKNOWLEDGEMENTS

The authors thankfully acknowledge the guidance and facilities provided by The Head Crop Protection Division and The Director, CICR is duly acknowledged.

Funding- Not applicable since it is review article.

Conflicts of interest/ Competing interests: It is declared that there is no conflict of interest of any financial and personal relationships with other people

or organizations that could inappropriately influence present work

Ethics approval: The present investigations do not involve Human Participants and/ or Animals in the experiments; hence prior consent is not applicable.

Consent to participate: All authors consented for to be author of the article.

Consent for publication: All authors consented for publication of the article.

Availability of data and material: Not applicable

Code availability: Not applicable.

Authors' contributions: All authors contributed equally.

## REFERENCES

- Abbas M, Afzal M. 1945. Cotton jassid (*Empoasca devastans* Dist) in the Punjab, VI. Species found on the cotton plant in Punjab. Indian Journal of Agricultural Sciences 15(3): 119-124.
- Aggarwal N, Neetan 2014. Predatory Efficiency of *Cheilomenes sexmaculata* (Fabricius) and *Chrysoperla zastrowi sillemi* (Esben – Petersen) on Cotton Mealy Bug, *Phenacoccus solenopsis* Tinsley under Laboratory Conditions. Acta Phytopathologica et Entomologica Hungarica 49 (1): 73-81.
- Ahmad T, Ullah G. 1939. Ecological studies on the spotted bollworms of cotton and their parasites. I. The preimaginal development and viability of *Earias fabia* and *Microbracon lefroyi* under different conditions of temperature and humidity. Indian Journal of Entomology 1: 17-47.
- Ananthakrishnan T, Raman K, Sanjayan K. 1982. Comparative growth rate, fecundity and behavioural diversity of the dusky cotton bug, *Oxycaenus hyalinipennis* Costa (Hemiptera: Lygaeidae) on certain Malvaceous host plants. Proceedings of the Indian National Science Academy. Part B: Biological sciences 48 (5): 577-584.
- Armes N J, Wightman J A, Jadhav D R, Ranga Rao G V. 1997. Status of insecticide resistance in *Spodoptera litura* in Andhra Pradesh, India. Pesticide Science 50: 240-248.
- Arora R, Dhawan A K, Jindal V. 2007. Ecological basis for the outbreak of tobacco caterpillar *Spodoptera litura* on cotton. Indian Journal of Ecology 34(1):88-89.
- Arora R, Jindal V, Rathore P, Kumar R, Singh V, Baja L. 2005. Integrated Pest Management of Cotton in Punjab, Punjab Agricultural University Regional Station. Faridkot-151203, India.
- Atwal A S, Dhaliwal G S. 1997. Agricultural pests of South Asia and their Management. Kalyani Publishers, New Delhi.
- Ayyar P N K. 1941. The Biology and distribution of the parasites of the Cotton Stem Weevil, *Pemphere affinis* Fst. in South India. Paper read at the Second Conference of Scientific Research Workers on Cotton in India, 1941.
- Ayyar T V R. 1930. Contribution of our knowledge of South Indian Coccidae (scales and Mealybugs). Bulletin of Imperial Agricultural Research Institute, Pusa 197: 1-73.
- Ayyar T V R. 1932. Insects attacking cotton plant in India. Madras Agriculture Department Bulletin 28: 1-28.

- Ballal C R, Akbar S A, Yamada K, Wachkoo A A, Varshney R. 2018. Annotated catalogue of the flower bugs from India (Heteroptera: Anthocoridae, Lasiochilidae). *Acta Entomologica* 58(1): 207–226.
- Ballard E. 1920. A Note on *Heliothis* (Chloridea) *obsoleta* Fb., as a pest of cotton. *Agriculture Journal of India* 4: 462-464.
- Ballard E. 1923. *Platyedra gossypiella* in South India. *Memoirs of the Department of Agriculture, Indian Entomology Service* 7:171–193.
- Basarkar C D, Nikam P K. 2013. Longevity, fecundity and sex-ratio of *Goryphus nursei* (Cam.) (Hymenoptera, Ichneumoidae), a solitary parasitoid of *Earias vittella* Stoll (Lepidoptera, Arctiidae). *Journal of applied Entomology* 93 (2): 213-216
- Basu A K. 1986. Resurgence of whitefly in cotton and strategies for its management. In “*Resurgence of sucking pests*”. Proc. Natl. Symp. (S. Jayaraj. Ed.), Tamil Nadu Agricultural University. Coimbalore 129-133.
- Beevi S P, Balasubramanian M. 1992. Relative Safety of Buprofezin and Insecticides to *Encarsia shafeei* a parasite of cotton whitefly *Bemisia tabaci* Genn. *Journal of Biological Control* 6 (2): 59-63.
- Bharathi K, Muthukrishnan N. 2017. Survey and Records of Mealy Bugs Species on Cotton and Alternate Host of Key Mealy Bug *Phenacoccus solenopsis* Tinsley and its Natural Enemies Complex in Major Cotton Growing Areas of South Tamil Nadu, India. *International Journal of Current Microbiology and Applied Science* 6 (12): 1047-1054.
- Bhardwaj J R, Ganguli J L, Khan H H, Sahu R. 2017. Bionomics of the rice meal moth, *Corcyra cephalonica* (Stainton) reared under laboratory condition on different diets. *Journal of Entomology & Zoology Studies* 5(5): 722-727.
- Bhat A I, Jain R K, Chaudhary V, Krishna Reddy M, Ramaiah M, Chattannavar S N, Varma A. 2002. Sequence conservation in the coat protein gene of Tobacco streak virus isolates causing necrosis disease in cotton, mungbean, sunflower and sunn-hemp in India. *Indian Journal of Biotechnology* 1: 350-356.
- Brar K S, Sekhon B S, Singh J, Shenhmar M, Singh J. 2002. Biocontrol based management of cotton bollworms in the Punjab. *Journal of Biological Control* 16(2): 121-124.
- CABI EPP0, 2007. *Eutetranychus orientalis*. (Distribution map). In: *Distribution Maps of Plant Pests*, Wallingford, UK: CABI. Map 688.
- Chakraborty D, Korat D M. 2009. Feeding efficiency of Green lacewing, *Chrysoperla carnea* (Stephens) on different species of aphids. *Karnataka Journal of Agricultural Science* 23 (5): 793-794.
- Chakraborty P, Prabhu S T, Balikai R A, Udikeri S S. 2015. Biology of cotton flower bud maggot, *Dasineura gossypii* Fletcher – An emerging pest on Bt cotton in Karnataka, India. *Journal of Experimental Zoology, India* 18 (1): 143-146.
- Channabasava, Borad P K. 2019. Incidence of termites in Bt cotton in relation to weather parameters. *Journal of Entomology & Zoology Studies* 7(3): 863-867.
- Channabasavanna G P, Puttarudriah M. 1959. *Hemitarsoememus latus* Banks, a potential pest of cotton in Mysore. *Science & Culture* 25(5): 322-323.
- Channabasavanna G. P. 1966. A contribution to the knowledge of Indian eriophyid mites (Eriophyoidea, Trombidiformes, Acarina). *University Agriculture Science Bulletin, Bangalore*, 153.
- Chant D A. 1960. Descriptions of five new species of mites from India (Acarina Phytoseiidae, Aceosejidae). *Canadian Entomology* 92(1): 58–65.
- Cherian M C, Kylasam M S. 1941. Preliminary Notes on The Parasites of the spotted and the Pink bollworms of cotton in Coimbatore. Paper Presented at the Second Conference of Scientific Research Workers on Cotton in India, 1941. Available at <https://www.ias.ac.in/article/fulltext/secb/014/06/0517-0528>. (accessed on 8 April 2020).
- Cherian M C. 1938. Mite (Acarina) pests of crops in south India and methods for their control. *Agriculture and Live-Stock India* 8 (5): 537-540
- CICR, 2010. Annual Report 2009-10, ICAR-Central Institute for Cotton Research, Nagpur India.
- CICR, 2018. Annual Report 2017-18, Central Institute for Cotton Research, Nagpur India.
- CICR, 2020. Annual Report 2020, ICAR-Central Institute for Cotton Research, Nagpur India.
- Dastur R H, Asana R D, Sawhney K, Sikka S M, Vasudeva R S, Khan Q, Rao V P, Seth B L. 1960. Cotton in India- A Monograph. Published by Indian Central Cotton Committee, Bombay, 339.
- David B V, Ramamurthy V V. 2017. *Element of Economic Entomology*. 8<sup>th</sup> Edition.
- Deshpande B P, Nadkarny N T. 1936. The spotted bollworms of cotton (*Earias fabia* Stoll. and *Earias insulana* Boisd.) in South Gujarat, Bombay Presidency. Scientific Monograph No 10: Report on Investigation financed by the Indian Central Cotton Committee (1923-1931), India.
- Dhara Jothi B, Prakash A H., Venkatesan R, Gnana P J. 2018. Tea Mosquito Bug *Helopeltis theivora* Waterhouse (Hemiptera: Miridae): A New Pest on Cotton. *Cotton Research Journal* 9 (1&2): 61-63.
- Dhara Jothi B, Surulivelu T, Gopalakrishnan N, Amutha M, Manjula T R, Kumaran N. 2009. Natural occurrence of *Spalgis* sp. (Lepidoptera: Lycaenidae) as predator on mealybug *Paracoccus marginatus* Williams and Granara de Willink on cotton. *CICR Newsletter* 25, 4.
- Dhara Jothi B, Surulivelu T, Gopalakrishnan N, Manjula T R. 2009. Occurrence of papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae), on cotton. *Journal of Biological Control* 23(3): 321-323.
- Dhawan A K, Aneja A, Saini S. 2009. First record of *Phenococcus solenopsis* Tinsely (Homoptera: Pseudococcidae) on cotton in Punjab. *Journal of Insect Science* 22(3): 309-310.
- Dhawan A K, Singh J, Sidhu A S. 1980. *Maconellicoccus* sp. attacking *Gossypium arboreum* cotton in Punjab. *Science & Culture* 46: 258.
- Dhawan A K. 2016. Integrated Pest Management in Cotton. In *Integrated Pest Management in the Tropics* (Ed. Dharam P. Abrol), New India Publishing Agency, New Delhi (India) 499-575.
- Dhobi C B, Bharpoda T M, Borad P K. 2014. First record of *Paracoccus marginatus* Williams and Granara de Willink and *Rastrococcus iceryoides* (Green) on Bt cotton (*Gossypium hirsutum* L.) in Gujarat. *Insect Environment* 20(1): 6-7.
- Dumaniya S G, Patel M B, Siddhapara M R, Kapadiya I B. 2015. Feeding potential of lady bird beetle, *Cryptolaemus montrouzieri* (Mulsant) on cotton mealybug, *Phenacoccus solenopsis* (Tinsley). *Journal of Cotton Research & Development* 29 (2): 311-314.
- Dutt G R, Patel M S. 1943. The cotton bollworms (*Earias fabia* Stoll, *Platyedra gossypiella* Saund. and *Heliothis obsoleta* Fabr.) in the central provinces and Berar. *Indian Journal of Agriculture Science* 13: 1-17.
- Fand B B, Naik V C N, Nagrare V S, Narkhedkar N G, Waghmare V N. 2019. Management of Fall armyworm *Spodoptera frugiperda* Smith in Cotton (Marathi). *Agrowon*, 25 September 2019.
- Fand B B, Gautam R D, Suroshe S S. 2010. Comparative biology of



- four coccinellid predators of solenopsis mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae). *Journal of Biological Control* 24 (1): 35-41.
- Fand B B, Gautam R D, Suroshe S S. 2011. Suitability of various stages of mealybug, *Phenacoccus solenopsis* (Homoptera: Pseudococcidae) for development and survival of the solitary endoparasitoid *Aenasius bambawalei* (Hymenoptera: Encyrtidae), *Biocontrol Science and Technology* 21: 51-55.
- Fand B B, Nagrare V S, Gawande S P, Nagrale D T, Naikwadi B V, Deshmukh V, Narkhedkar N G, Waghmare V N. 2019. Widespread infestation of Pink bollworm, *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae) on Bt cotton in Central India: a new threat and concerns for cotton production. *Phytoparasitica*, <https://doi.org/10.1007/s12600-019-00738>.
- Fand B B, Suroshe S S. 2015. The invasive mealybug *Phenacoccus solenopsis* Tinsley, a threat to tropical and subtropical agricultural and horticultural production systems - a review. *Crop Protection* 69: 34-43.
- Fand B B, Tonnang H E Z, Kumar M, Kamble A L, Bal S K. 2014a. A temperature-based phenology model for predicting development, survival and population growth potential of the mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae). *Crop Protection* 55: 98-108.
- Fand B B, Tonnang H E Z, Kumar Mahesh, Bal S K, Singh N P, Rao D V K N, Kamble A L, Nangare D D, Minhas P S. 2014b. Predicting the impact of climate change on regional and seasonal abundance of the mealybug *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) using temperature-driven phenology model linked to GIS. *Ecological Modelling* 288: 62-78.
- Fand B B, Kumar M, Kamble A L. 2014c. Predicting the potential geographic distribution of cotton mealybug *Phenacoccus solenopsis* in India based on MAXENT ecological niche model. *Journal of Environment & Biology* 35(5): 973-82.
- Fand B B. 2009. PhD Thesis on ecological studies on mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae), selected coccinellids and an Encyrtid Parasitoid. IARI New Delhi.
- Fletcher T B. 1914. Some South Indian insects and other animals of importance considered especially from an economic point of view. Printed by the Superintendent, Government press, Madras. 565p.
- Fletcher T B. 1919. Second hundred notes on Indian insects. *Bulletin, Agricultural Research Institute, Pusa*, 89: 1-102.
- Gautam S, Singh A K, Gautam D. 2009. Comparative life table analysis of chrysopids reared on *Phenacoccus solenopsis* Tinsley in laboratory. *Journal of Biological Control* 23(4): 393-402.
- Gupta A, Poorani J. 2008. New distribution and host records of Chalcidoidea (Insecta: Hymenoptera) from various parts of India, *Check List* 4(4): 410-414.
- Gupta S K. 1975. Mites of the genus *Amblyseius* (Acarina: Phytoseiidae) from India with descriptions of eight new species. *International Journal of Acarology* 1(2): 26-45.
- Gupta S K. 1977. New species and records of *Typhlodromus* and *Phytoseius* from eastern India (Acarina: Phytoseiidae). *Indian Journal of Acarology* 2: 1-11.
- Gupta S K. 1985. *Handbook: Plant Mites of India*. Zoological Survey of India, Kolkata.
- Gupta S K. 1987. A taxonomic review of oriental phytoseiidae with keys to genera and species. *Records of the Zoological Survey of India. Miscellaneous Publication Occasional Paper No. 95*.
- Gupta V K, Tikar D T. 1967. Indian species of *Scambus* Hartig (Hymenoptera: Ichneumonidae), *Oriental Insects* 1(3-4): 215-237.
- Hampson G F. 1896. *Fauna of British India-Lepidoptera*. London. 4: 360.
- Hargreaves H. 1948. *List of recorded cotton insects of the world*. Common Wealth Institute of Entomology, London, 50pp.
- Hayat M. 2009. Description of a new species of *Aenasius* Walker (Hymenoptera: Encyrtidae), parasitoid of mealybug, *Phenacoccus solenopsis* Tinsley (Homoptera: Pseudococcidae). *Biosystematica* 3: 21-25.
- Husain M A, Trehan K N, Verma P N. 1936. Studies on *Bemisia gossypiperla* M & L. III. Seasonal activities of *Bemisia gossypiperla* M & L (the whitefly of cotton) in Punjab. *Indian Journal of Agriculture Science* 6 (4): 893-903.
- Husain M A, Trehan K N. 1933. Observations on the life history, bionomics and control of the whitefly of cotton (*Bemisia gossypiperla* M & L). *The Indian Journal of Agricultural Sciences* 3 (5): 701-753.
- Husain M A. 1931. A preliminary note on the whitefly of cotton in the Punjab. *Agriculture Journal of India* 25 (6): 507-526
- Husain M A. 1937. The cotton jassid. *Indian Central Cotton Committee 1<sup>st</sup> Commence Scientific Research Wrks. Cotton India, Cotton Entomology*, 66-73
- Jagmohan 2001. Natural enemies of insect pests recorded from Punjab. *Biological control contributed paper PAU, Ludhiana*, pp1
- Jagtap G P, Jadhava T H, Utpala D. 2012. Host range and transmission of Tobacco streak virus (TSV) causing cotton mosaic disease. *Scientific Journal of Veterinary Advances* 1(1): 22-27.
- Jayaraj S, Rangarajan A V, Murugesan S, Santharamj G, Jayaraghavan S V, Thangaraj D. 1986. Studies on the outbreak of whitefly, *Bemisia tabaci* (Gennadius) on cotton in Tamil Nadu. In Jayaraj S. (Ed.) *Resurgence of sucking pests. Proceedings of National Symposium. Coimbatore, India, Tamil Nadu Agricultural University*. pp 225-240.
- Jeyaparvathi S, Baskaran S, Bakavathiappan G. 2013. Population Dynamics of spiders in selected cotton fields of Virudhunagar district, Tamil Nadu, India. *Munis Entomology & Zoology* 8 (2): 560-570.
- Jhala R C, Bharpoda T M, Patel M G. 2008. *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae), the mealy bug species recorded first time on cotton and its alternate host plants in Gujarat, India. *Uttar Pradesh Journal of Zoology* 28(3): 403-406.
- Jhala R C, Solanki R F, Bharpoda T M, Patel M G. 2009. Occurrence of Hymenopterous Parasitoids *Aenasius bambawalei* Hayat and *Promuscidea unfaciativentris* Girault on Cotton Mealybugs *Phenacoccus solenopsis* Tinsley in Gujarat. *Insect Environment* 14 (4): 164-165
- Jhaveri T N. 1921. Notes on cotton wooly mite (*Eriophyes gossypii*). Report of the Proceedings of forth. *Entomological Meeting Pusa*, 96-97.
- Jose V T, Shah A H, Patel C B. 1989. Feeding potentiality of some important predators of spider mite, *Tetranychus macfarlanei*, a pest of cotton. In: *Progress in Acarology* (Eds. G. P. Channa Basavanna & C. A. Viraktamath), Oxford IBH Pub. House, New Delhi, 2: 357-360.
- Jose V T, Shah A H. 1989. Carryover of spider mite, *Tetranychus macfarlanei* through alternate host plants in cotton growing areas of south and central Gujarat, India. In: Channabasavanna G P, Viraktamath C A, editors. *Progress in Acarology*. New Delhi: Oxford & IBH Publishing p 29-31.
- Joshi B C, Yadav D N. 1990. Biology and feeding potential of *Mallada boninensis* (Okamoto), a Chrysopid Predator of Whitefly *Bemisia tabaci* Gennadius. *Journal of Biological Control* 4(1): 18-21.



- Kataria R, Kumar D. 2012. Occurrence and infestation level of sucking pests: Aphids on various host plants in agricultural fields of Vadodara, Gujarat (India). *International Journal of Scientific & Research Publications* 2(7): 1-6.
- Kedar S C, Saini R K, Ram P. 2011. Record of coccinellid predators associated with solenopsis mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) from Haryana. *Journal of Entomological Research* 35(3): 245-246
- Khan A R. 1940. Important insect predators of India. Page 67-74. Available at <https://www.ias.ac.in/article/fulltext/secb/012/03/0067-0074>. (Accessed on 8 April 2020).
- Khan Q, Rao V P. 1960. Insects and mites. In: Cotton in India: a monograph, Vol 2. Indian Central Cotton Committee, Bombay, pp. 217-301, 474 p
- Khan M Q. 1956. Cotton semilooper, *Anomis flava* Fb., in Hyderabad State. *Indian Journal of Entomology* 18(4): 461-462.
- Kiranmai K, Sammaiah C H. 2018. Diversity of soil arthropod community in Bt and Non-Bt cotton fields of Karimnagar District Telangana. "IOSR Journal of Agriculture & Veterinary Science 11(12): 1-4.
- Kotikal Y K, Math M. 2016. Insect and non-insect pests associated with Drumstick, *Moringa oleifera* (Lamk.). *Journal of Global Biosciences*, 5(4): 3902-3916.
- Kranthi K R, Jadhav D R, Kranthi S, Wanjari R R, Ali S, Russell D. 2002. Insecticide resistance in five major insect pests of cotton in India. *Crop Protection* 21: 449-460.
- Kranthi K R, Russell D. 2009. Changing trends in Cotton Pest Management. Peshin R, Dhawan A K (eds.). *Integrated pest management: Innovation-development process*, C Springer Science Business. pp 499-541
- Kranthi K R. 2015a. Pink bollworm strikes Bt-Cotton. *Cotton Statistics & News*. Cotton Association of India. 1<sup>st</sup> December 2015.
- Kranthi K R. 2015b. Whitefly –the black story. *Cotton Statistics & News*. Cotton Association of India. No. 23, 8th September, 2015
- Kranthi S, Ghodke A B, Raghavendra K P, Mandle M, Nandanwar R, Satija U, Pareek R K, Desai H, Udikeri S S, Dhara Jothi B, Bheemanna M H, Monga D, Kranthi K R. 2017. Mitochondria COI-based genetic diversity of the cotton leafhopper *Amrasca biguttula biguttula* (Ishida) populations from India. *Mitochondrial DNA Part A*, DOI: 10.1080/24701394.2016.1275595.
- Krishnamoorthy A, Mani M. 1989. Studies on the biology and rearing of an indigenous parasitoid *Eriborus argenteopilosus* Cam. (Hym., Ichneumonidae). *Journal of Biological Control* 3(2): 80-82.
- Rishi Kumar, Monga D, Nitharwal M. 2010. *Spodoptera exigua* - An emerging pest of cotton. *CICR Newsletter*, Central Institute for Cotton Research, Nagpur, July - September 2010 26(3): 1-8
- Lal K B, Singh C. 1953. The cotton leaf roller, *Sylepta derogata* Fabr. (i) Relative incidence on *Hirsutum cottons*, (ii) Control. *Indian Cotton Growing Review* 7(2): 77
- Laxman P, Samatha Ch, Sammaiah Ch. 2014a. Study on infestation of sucking insect pests on Bt-Cotton and non Bt- Cotton fields in Warangal Telangana. *International Journal of Advanced Biological Research* 4(2): 172-177.
- Laxman P, Samatha Ch, Thirupati U, Sammaiah Ch. 2014b. Study on defoliator pests in Bt- Cotton and non Bt-Cotton Fields in Warangal, Andhra Pradesh, India. *International Journal of Pharmacy & Biological Sciences* 4(1): 150-156.
- Lefroy H M. 1906. Pests of the cotton plant. In *Indian Insect pests*, Office of the Superintendent of Government Printing Calcutta, India, 1-318.
- Mahalakshmi R, Jeyaparvathi S. 2014. Diversity of spider fauna in the cotton field of Thailakulam, Virudhunagar District, Tamil Nadu, India. *The Journal of Zoology Studies* 1(1): 12-18.
- Maheswariah B M, Puttarudriah M. 1956. Insect pests of cotton in Mysore. *Mysore Agriculture Journal* 31: 220-226.
- Mandal S K, Dey A, Hazra A K. 2007. Pictorial Handbook on Indian short-horned grasshopper pests (Acridoidea: Orthoptera):1-57. (Published by the Director, Zoological Survey of India, Kolkata).
- Marrlatt C L. 1918. The origin of the pink bollworm. *Science* 48(1239): 309-312.
- Misra C S, Lambda S K. 1929. The cotton whitefly (*Bemisia gossypiperda* n. sp.). *Bulletin of Agriculture Research Institute Pusa* 196: 1-7.
- Misra C S. 1913. The red spider on Jute (*Tetranychus bioculatus* Wood-Mason). *Agriculture Journal of India* 8 (4): 309-316.
- Misra C S. 1920. Some pests of cotton in North Bihar. *Reports of Proceedings of third Entomology Meeting, Pusa, Calcutta*, 547-561.
- Misra C S. 1921. *Oxycaenus laetus*, the dusky cotton bug. *Reports of Proceedings of forth Entomology Meeting, Pusa*, 84-92.
- Mitra B, Roy S, Imam I, Ghosh M. 2015. A review of the hover flies (Syrphidae: Diptera) from India. *International Journal of Fauna & Biological Studies* 2(3): 61-73.
- Mohan S, Monga D, Kumar R, Nagrare V, Gokte-Narkhedkar N, Vennila S, Tanwar R K, Sharma O P, Bhagat S, Agarwal M, Chattopadhyay C, Kumar R, Birah A, Amaresan N, Singh A, Sushil S N, Asre R, Kapoor K S, Jeyakumar P, Satyagopal K. 2014. *Integrated Pest Management Package for Cotton*. p. 84.
- Mohapatra L N. 2004. Natural enemies of insect pests of cotton in Orissa. *Journal of Biological Control* 18: 195-197.
- Muesebeck C F W. 1956. Some braconid parasites of the bollworm (*Pectinophora gossypiella* Saund.). *Bollettino del Laboratorio di zoologia generale e agraria della R. Scuola superiore d'agricoltura in Portici* 33: 55-58.
- Mukherjee A K, Chahande P R, Meshram M K, Kranthi K R. 2012. First report of *Polerovirus* of the family *Luteoviridae* infecting cotton in India. *New Disease Reports* 25, 22. ([http:// dx.doi.org/ 10.5197/ j.2044-0588.2012.025.022](http://dx.doi.org/10.5197/j.2044-0588.2012.025.022))
- Murugesan N, Kavitha A. 2010. Host plant resistance in cotton accessions to the leafhopper, *Amrasca devastans* (Distant). *Journal of Biopesticides* 3(3): 526-533.
- Nagrare V S, Fand B B, Naikwadi B V, Deshmukh V. 2019. Potential risk of establishment and survival of cotton aphid *Aphis gossypii* in India based on simulation of temperature-dependent phenology model. *International Journal of Pest Management*. [https:// doi. org/ 10.1080/ 09670874. 2019.1649739](https://doi.org/10.1080/09670874.2019.1649739)
- Nagrare V S, Kranthi S, Biradar V K, Zade N N, Sangode V, Kakde G, Shukla R M, Shivare D, Khadi B M, Kranthi K R. 2009. Widespread infestation of the exotic mealybug species, *Phenacoccus solenopsis* (Tinsley) (Hemiptera: Pseudococcidae), on cotton in India. *Bulletin of Entomological Research* 99: 537-541.
- Nagrare V S, Kranthi S, Rishi Kumar, Dhara Jothi B, Amutha M, Deshmukh A J, Bisane K D, Kranthi K R. 2011. *Compendium of Cotton Mealybugs*. Central Institute for Cotton Research, Nagpur, P 42.
- Nagrare V S, Rishi Kumar, Amutha M, Dhara Jothi B, Kranthi S. 2014b. Role of Arthropods Biodiversity in containing cotton infesting mealybugs. In: *Book of Abstracts, 6th Meeting of the Asian Cotton Research & Development Network, Dhaka, Bangladesh, June 18-20, 2014*.
- Nagrare V S, Rishi Kumar, Dhara Jothi B. 2014a. A record of five

- mealybug species as minor pests of cotton in India. *Journal of Entomology & Zoology Studies* 2(4): 110-114.
- Nagrare V S, Naikwadi B, Bhojar P. 2015. Parasitoid *Pseudoleptomastix mexicana* parasitizes *Paracoccus marginatus* in Central India. *CICR Newsletter*, 4(3), March. 2015.
- Nagrare V S., Deshmukh V, Naikwadi B, Bhojar P, Khadakkar S. 2015. Spider diversity in transgenic and non-transgenic cotton in rainfed agro ecosystem of central India. *Research Journal of Biotechnology* 10(12): 76-84
- Naik V C B, Kranthi S, Gharade S, Kumbhare S, Nagrare V S, Singh L R K. 2018. Endoparasitoid: *Bracon Lefroyi* (Dudgeon & Gough) of Pink Bollworm *Pectinophora Gossypiella* (Saunders) on cotton. *Indian Journal of Entomology* 80(2): 361-366.
- Naik V C B, Kumbhare S, Kranthi S, Satija U, Kranthi K R. 2018. Field evolved-resistance of Pink bollworm *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae) to transgenic *Bt*-cotton expressing Cry1Ac and Cry2Ab in India. *Pest Management Science* Doi: 10.1002/ps.5038.
- Naik V C B, Nagrare V S, Subbireddy K B, Kumbhare S, Wawdhane P, Prabhulinga T. 2019. Management of Cotton Pink bollworm *Pectinophora Gossypiella* (Saunders) with *Trichogramma Bactrae* and *T. Brasiliensis*. *Indian Journal of Entomology* 81(4): 744-748
- Naik V C B, Pusadkar P P, Waghmare S T, Raghavendra K P, Kranthi S, Kumbhare S, Nagrare V S, Rishi Kumar, Prabhulinga T, Gokte-Narkhedkar N, Waghmare V N. 2020. Evidence for population expansion of Cotton pink bollworm *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae) in India. *Scientific Reports* 10: 4740. <https://doi.org/10.1038/s41598-020-61389-1>
- Naik V C B, Naga h, Giri N H, Kumbhare S, Kranthi S, Kumar N. 2019. New Report of *Oxycetonia versicolor* Fabricius, as a pest on cotton from central India. *National Academy of Science Letters* 42(5): 387-390.
- Nair M R G K. 1975. Insects and mites of crops in India, Indian Council of Agricultural Research New Delhi, p 408.
- Nalini T, Manickavasagam S. 2011. Records of Encyrtidae (Hymenoptera: Chalcidoidea) parasitoids on mealybugs (Hemiptera: Pseudococcidae) from Tamil Nadu, India. *Encyrtidae parasitoids on Pseudococcidae. Check List* 7(4): 510-515.
- Nangpal H D. 1948. Insect pests of cotton in India, Indian Central Cotton Committee p 1-51.
- Narayanan E S, Kaur R B. 1960. Two new species of the genus *Typhlodromus* Scheuten from India (Acarina: Phytoseiidae). *Proceedings of Indian Academy of Sciences* 51B:1-8.
- Narayanan E S, Subba Rao B R, Chacko M J. 1959. *Aholcus euproctiscidis* mani (Scelionidae: Hymenoptera), an egg parasite of *euproctis lunata* Walker. *Proceedings of the Indian Academy of Sciences, Section B* 49 (1): 74-81.
- Naresh J S, Balan J S, 1984. Observations on *Pyroderces simplex* Walsingham (Lepidoptera: Momphidae) in Haryana. *Indian Journal of Entomology* 46(3): 368-370.
- Nasir M M. 1947. *Crysopa cymbele* Banks and its two new varieties. *Indian Journal of Entomology* 8(1):119-120.
- Natarajan K, Seshadri V. 1988. Abundance of natural enemies of cotton insects under intercropping system. *Journal of Biological Control* 2 (1): 3-5.
- Natarajan K. 1990. Natural enemies of *Bemisia tabaci* Gennadius and effect of insecticides on their activity. *Journal of Biological Control* 4 (2): 86-88.
- Nimbalkar S A. 2007. Integrated pest management in cotton. *Indian Entomology: Novel Approaches* (Edited by P. C. Jain, M. C. Bhargava), New India Publishing, 550 p.
- Nisha R, Kennedy J S. 2017. Life cycle of the parasitoid *Acerophagus papaya* Noyes and Schauf on papaya mealybug *Paracoccus marginatus* Williams and Granara de Willink *vis-a-vis* local adaptation with coevolutionary “Arms Race”. *Journal of Entomology & Zoology Studies* 5(3): 1711-1719.
- Omkar P A. 2001. Prey preference of a ladybeetle, *Micraspis discolor* (Fabricius). *Entomol* 26(2): 195-197.
- Omkar, Pervez A. 2002. Ecology of aphidophagous Ladybird Beetle, *Coccinella Septempunctata* (Coleoptera: Coccinellidae): A Review. *Journal of Aphidology* 16: 175-201.
- Parameswaran S, Chelliah S. 1984. Damage potential and control of cotton stem weevil, *Pempherulus affinis*. *Tropical Pest Management* 30(2): 121-124.
- Pardeshi M K, Kumar D, Bhattacharyya A K. 2010. Termite (Insecta: Isoptera) fauna of some agricultural crops of Vadodara, Gujarat (India). *Records of the Zoological Survey of India* 110(1): 47-59.
- Patel J C, Patel R C. 1971. Studies on the biology of *Chelonus heliopa* Gupta, an egg - larval parasite of *Spodoptera litura* (F.). *Indian Journal of Entomology* 33: 50 - 54.
- Patel R M, Vyas H N, Patel G R, Desai S S. 1963. First record of cotton stem borer (*Alcidodes* near *affaber*) on indo American cottons in Gujarat state. *Indian Cotton Growing Review* 17: 245-246.
- Patil B V, Bheemanna M, Patil S B, Udikeri S S, Hosmani A. 2006. Record of mirid bug, *Creontiades biseratense* (Distant.) on cotton from Karnataka, India. *Insect Environment* 11: 176-177.
- Patil S B. 2003. Studies on management of cotton pink bollworm *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae). Ph.D. Thesis submitted to University of Agricultural Sciences, Dharwad, Karnataka, (India).
- Pawar A D, Prasad J, Asre R, Singh R. 1983. Introduction of exotic parasitoid, *Chelonus blackburni* Cameron in India for the control of cotton bollworms. *Indian Journal of Entomology* 45(4): 436-439.
- Pillai K G, Krishnamoorthy A, Visalakshy P N G. 2009. First report of hyperparasitoids of *Anagyrus dactylopii* (Howard) from India. *Journal of Biological Control* 23(2):193-194.
- Ponnuswami M K, Ramaswamy A. 1975. Grubs of ash weevil *Myloccerus maculosus* Desb. on cotton and their control organised in Suler near Coimbatore. *Plant Protection Bulletin, India* 23(2): 28-29.
- Pramanik L M, Basu A C. 1975. Observations on *Lymantria ampla* Walker (Lymantriidae: Lepidoptera) Infesting Cotton. *Indian Journal of Entomology* 37(2):213-214.
- Prasad S N. 1956. Bionomics of *Oxycaremus latus* Kirby (Dusky cotton bug). *Bihar Academy of Agricultural Science Proceedings* 5: 47-61.
- Prema M S, Ganapathy N, Renukadevi P, Mohankumar S, Kennedy J S. 2018. Efficacy of different botanical extracts on *Thrips palmi* in cotton. *Journal of Pharmacognosy & Phytochemistry* 7(2): 2824-2829.
- Pruthi H S, Mani M S. 1940. Biological notes on Indian parasitic chalcidoidea. *Miscellaneous Bulletins of the Council on Agricultural Research in India* 30: 1-44.
- Pruthi H S. 1922. Morphology and biology of the red cotton bug (*Dysdercus cingulatus* Fbr.). *Journal and Proceedings of Asiatic Society, Bengal* 17(4): 148-149.
- Pruthi H S. 1940. Descriptions of some new species of *Empoasca* Walsh (*Eupterygidae*, *Jassoidea*) from North India. *Indian Journal of Entomology* 2(1): 1-10.
- Puri S N, Murthy K S, Sharma O P. 1999. Integrated Pest Management

- for Sustainable Cotton Production. In: Handbook of Cotton in India. Basu A K, Narayanan S S, Krishna Iyer K R and Rajendran T P (Eds). Indian Society for Cotton Improvement, Mumbai. pp. 223-255.
- Puttarudriah M. 1958. A dangerous potential pest of cotton. Indian Cotton Growing Review 12: 406-407.
- Qadri A H. 1933. *Rhogas aligharensi* sp.n. (a pink bollworm parasite). Current Science 2, 209.
- Rajeswaran J, Duraimurugan P, Shanmugam P S. 2005. Role of spiders in agriculture and horticulture ecosystem. Journal of Food, Agriculture & Environment 3(3&4): 147-152.
- Ram P, Chopra N P. 1988. Population dynamics of Dusky cotton bug, *Oxycarenus hyalipennis* Costa on cotton. Indian Journal Entomology 50(2): 161-164.
- Ram P, Saini R K, Vijaya. 2009. Preliminary studies on field parasitisation and biology of Solenopsis mealybug parasitoid, *Aenasius bambawalei* Hayat (Encyrtidae: Hymenoptera). Journal of Cotton Research & Development 23(2): 313-315.
- Ram P, Saini R K. 2010. Biological control of solenopsis mealybug, *Phenacoccus solenopsis* Tinsley on cotton: a typical example of fortuitous biological control. Journal of Biological Control 24(2): 104-109.
- Ramakrishnan N, Saxena V S, Dhingra S. 1984. Insecticide resistance in the population of *Spodoptera litura* (Fab.) in Andhra Pradesh. Pesticides 18: 23-27.
- Ramchandra Rao Y. 1924. A note on a new cotton bollworm *Rabila frontalis* Walker. Report of the Fifth Entomological Meeting, 1923, Pusa, 56-57.
- Rao V P, Mahadeva A M. 1964. A new record of a tachinid parasitizing spotted bollworms in India. Technical Bulletin Commonwealth Institute of Biological Control 4: 62.
- Rawat R R, Modi B N. 1969. Studies on *Nephus regularis* (Coleoptera: Coccinellidae) as a Predator of the Striped Mealybug in Madhya Pradesh (India). Annals of the Entomological Society of America 62(5): 953- 956.
- Rishi Kumar, Nagrare V S, Nitharwal M, Swami D, Prasad Y G. 2013. Within-plant distribution of an invasive mealybug, *Phenacoccus solenopsis*, and associated losses in cotton. Phytoparasitica, DOI 10.1007/s12600-013-0361-6.
- Rishi Kumar, Choudhary A, Kumar S, Shivangi. 2019. Frequency of alleles conferring resistance to Bt cotton in North Zone population of the spotted bollworm *Earias insulana* (Boisduval). African Entomology 27(1): 58-65.
- Rishi Kumar, Kranthi K R, Monga D, Jat S L. 2009. Natural parasitization of *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) on cotton by *Aenasius bambawalei* Hayat (Hymenoptera: Encyrtidae). Journal Biological Control 23(4): 457-460.
- Rishi Kumar, Kranthi S, Nagrare V S, Monga D, Kranthi K R, Rao N, Singh A. 2019. Insecticidal activity of botanical oils and other neem-based derivatives against whitefly, *Bemisia tabaci* (Gennadius) (Homoptera: Aleyrodidae) on cotton. International Journal of Tropical Insect Science [https:// doi.org/ 10.1007/s42690-019-00027-4](https://doi.org/10.1007/s42690-019-00027-4).
- Rishi Kumar, Monga D, Naik V C B, Singh P, Waghmare V N. 2020. Incipient infestations and threat of pink bollworm *Pectinophora gossypiella* (Saunders) on Bollgard-II cotton in north cotton growing zone of India. Current Science 118(9): 1454-1456.
- Routray S, Hari Prasad K V, Dey D. 2016. Effect of *Aphis craccivora* Koch. reared on different host plants on the biology of *Cheilomenes sexmaculata* (Fabricius). Journal of Biological Control 30(1): 19-24.
- Saha J L, Mitra B. 2016. Insects associated with Bt and non-Bt cotton plants in Tripura. Journal of Entomology & Zoology Studies 4(6): 331-334.
- Sahayaraj K, Muthu Kumar S, Enkegaard A. 2016. Response of the reduviid bug, *Rhynocoris marginatus* (Heteroptera: Reduviidae) to six different species of cotton pests. European Journal of Entomology 113: 29-36.
- Sahayaraj K. 2004. Indian Insect Predators in Biological Control, Daya Publishing House, New Delhi.
- Sammaiah C, Laxman P, Samatha C. 2012. Study on infestation of cotton insect stainers on Bt-cotton and non Bt-cotton in Warangal, Andhra Pradesh. International Journal of Environmental Sciences 3(3): 1155-1160.
- Sangha K S, Shera P S, Sharma S, Kaur R. 2018. Natural enemies of whitefly *Bemisia tabaci* (Gennadius) on cotton in Punjab, India. Journal of Biological Control 32(4): 270-274.
- Sankar C, Marimuthu R, Saravanan P, Jeyakumar P, Tanwar R K, Sathyakumar S, Bambawale O M, Ramamurthy V V, Barik A. 2011. Predators and parasitoids of cotton mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) in Perambalur district of Tamil Nadu. Journal of Biological Control 25(3): 242-245.
- Sathe T V, Mithari P. 2015. Occurrence and hosts for a destructive *Thrips tabaci* Lind. (Thysanoptera: Thripidae). International Journal of Recent Scientific Research 6(4): 2670-2672.
- Saunders W W. 1843. Description of a species of moth destructive to the cotton crop in India. Transactions Entomological Society London 3: 284-285.
- Saxena K N. 1965. Control of the orientation and feeding behaviour of Red cotton Bug, *Dysdercus koenigii* (F.) by chemical constituents of plants. Proceedings of XII<sup>th</sup> International Congress of Entomology, London pp. 294.
- Saxena Y P, Yadav A. 1982. Feeding Behaviour and Occurrence of *Dysdercus Similis* Freeman. (Hemiptera, Pyrrhocoridae). Deutsche Entomologische Zeitschrift 29(1-3): 49-50
- Sebastian P A, Sudhikumar AV, Davis S. 2004. Reproductive behaviour and biology of *Oxyopes chitrae* Tikader (Araneae: Oxyopidae) occurring on cotton. Zoos' Print Journal 19(5): 1477-1480.
- Sekhon B S, Varma G C. 1983. Parasitoids of *Pectinophora gossypiella* (Lepidoptera, Gelechiidae) and *Earias* Spp. (Lepidoptera, Noctuidae) in the Punjab. Entomophaga 28 (1): 45-54.
- Sen P C. 1924. The red cotton bug (*Dysdercus cingulatus* Fbr.). Bengal Agriculture Journal 4(2): 40.
- Sharma H C, Pampapathy G. 2006. Influence of transgenic cotton on the relative abundance and damage by target and non-target insect pests under different protection regimes in India. Crop Protection 25: 800-813.
- Shashank P R, Thomas A, Ramamurthy V V. 2015. DNA barcoding and phylogenetic relationships of *Spodoptera litura* and *S. exigua* (Lepidoptera: Noctuidae). Florida Entomologist 98(1): 223-228.
- Shelker U C, Ayyappan R. 2007. Exploring the Bt Cotton potential for the management of Semilooper complex, *Anomis flava* Fab. and *Tarache nitidula* Fab. Department of Entomology, Tamil Nadu Agricultural University, Coimbatore, India.
- Shinde A A, Dadmal S M, Gajbe N D, Mane V A. 2017. Seasonal occurrence and diversity of arthropods in Bt cotton ecosystem under Akola conditions of Maharashtra. Journal of Entomology & Zoology Studies 5(5): 1614-1619.
- Shivanna B K, Nagaraja D N, Manjunatha M, Gayathridevi S, Pradeep



- S, Girijesh G K. 2009. Bionomics of leafhopper, *Amrasca biguttula biguttula* (Ishida) on transgenic Bt cotton. Karnataka Journal of Agricultural Sciences 22(3): 538-540.
- Shylesha A N, Joshi S. 2012. Occurrence of Madeira mealybug, *Phenacoccus madeirensis* Green (Hemiptera: Pseudococcidae) on cotton in India and record of associated parasitoids. Journal of Biological Control 26(3): 272-273.
- Siliwal M, Kumar D. 2001. Rare sighting of poisonous spider *Latrodectus hasseltii indicus* Simon (Araneae: Theridiidae) in a cotton field in Baroda district, Gujarat. Current Science 18(9): 1170-1171.
- Singh A, Kumar D. 2017. Effect of Mealybug-Ants association on Parasitoid, *Aenasius bambawalei* Hayat (Hymenoptera: Encyrtidae) in Vadodara, Gujarat, India. Global Journal of Bio-Science & Biotechnology 6(2): 212-216.
- Singh A, Gandhi S. 2012. Agricultural insect pest: occurrence and infestation level in agricultural fields of Vadodara, Gujarat. International Journal of Scientific & Research Publications 2(4): 2250-3153.
- Singh S, Sidhu A S. 1958. Cotton thrips (*Thrips tabaci* Lindeman). Indian Journal of Entomology 20: 238-240.
- Siva Kumar D, Xavier I B. 2017. Araneae (Spiders) Fauna of cotton Agroecosystem in Nanguneri, Tirunelveli, Tamil Nadu. World Journal of Pharmaceutical and Life Sciences 3(9): 155-158.
- Siva Kumar D. 2017. Biodiversity of entomofauna in cotton field in and around Nanguneri Taluk, Tirunelveli District, Tamil Nadu, South India. Ph.D Thesis to Manonmaniam Sundaranar University Tirunelveli-627.
- Sohi A S. 1983. The oriental Typhlocybinae with special reference to the pests of cotton and rice: a review. Proceedings of the 1<sup>st</sup> International Workshop on Leafhoppers and Planthoppers of Economic Importance. Commonwealth Institute of Entomology, London, 4-7 Oct. 1982. London. P. 49-74.
- Somchoudhury A K. 1979. Seasonal fluctuation of population of *Amblyseius delhiensis*, a predator on eggs of cotton jassid. First All India Symposium on Acarology, Bangalore, p. 50 (Abst.).
- Srinivasan G, Prabhakar D. 2013. A pictorial handbook on grasshoppers of Western Himalayas. Zoological Survey of India, M-Block, New Alipore, Kolkata.
- Subba Rao B R. 1966. Records of known and new species of mymarid parasites of *Empoasca devastans* Distant from India. Indian Journal of Entomology 28(2): 187-196.
- Subramanian K, Kitherian S. 2012. Survey of reduviids in cotton agro-ecosystem of Tamil Nadu, India. Middle-East Journal of Scientific Research 12 (9): 1216-1223.
- Subramanian T R. 1959. The biology *Alcidodes affaber* Aurivillius. Indian Journal Agricultural Science 29(4): 81-89.
- Sundaramurthy V T. 1992. Upsurgence of whitefly *Bemisia tabaci* Gen. in the cotton ecosystem in India. Outlook on Agriculture 21(2):109-115.
- Sundarmurthy V T, Chitra K. 1992. Integrated pest management in cotton. Indian Journal of Plant Protection 20 (1): 1-17.
- Suroshe S S, Gautam R D, Fand B B. 2013. Natural enemy complex associated with the mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) infesting different host plants in India. Journal of Biological Control 27 (3): 204-210.
- Surulivelu T, Dhara Jothi B. 2007. Mirid Bug, *Creontiodes biseratense* (Distant.) damage on Cotton in Coimbatore. [http:// www.cicr.org.in](http://www.cicr.org.in)
- Talat P, Bhandari P, Raza S K. 2016. Survey and Identification of Termite in Some Selected Parts of India. Life Science Informatics Publication. [www.rjlbpcs.com](http://www.rjlbpcs.com).
- Tanwar R K, Bhamare V K, Ramamurthy V V, Hayat M, Jeyakumar P, Singh A, Bambawale O M. 2008. Record of new parasitoids on mealybug, *Phenacoccus solenopsis*. Indian Journal of Entomology 70: 404-405.
- Tanwar R K, Jeyakumar P, Monga D. 2007. Mealybugs and their management. Technical Bulletin 19, National Centre for Integrated Pest Management, New Delhi, India.
- Tanwar R K, Jeyakumar, Vennila S. 2010. Papaya mealybug and its management strategies, Technical Bulletin 22, National Centre for Integrated Pest Management, New Delhi. pp. 22.
- Thakar B J, Desai M H. 1929. Woolly-mites (*Eriophyes gossypii*) on cotton. Its status and economic importance in Gujarat. Agriculture Journal of India 24: 175-182.
- Thimmaiah G, Kulkarni G, Bhat K A. 1975. Occurrence of the shoot weevil *Acidodes affaber* Aurivillius on cotton and Bhendi. Current Research 4: 104-105.
- Thomas A, Ramamurthy V V. 2011. On the diagnostics of mealybug occurring on cotton, spherical mealybug *Nipaeococcus viridis* (Newstead) (Hemiptera: Pseudococcidae). Munis Entomological Zoology 6 (1): 455-459.
- Thompson W R. 1946. A Catalogue of the parasites and predators of insect pests. Section I. Parasite host catalogue. Part 7 Parasites of the Lepidoptera (G-M). pp. 441.
- Thompson W R. 1950. A catalogue of the parasites and predators of insect pests. Section I-Part 3. Parasites of Hemiptera (2<sup>nd</sup> Ed.), 149.
- Tiwari S P, Nema S, Khare M N. 2013. Whitefly- a strong transmitter of plant viruses. Journal of Plant Pathology 2: 102-120.
- ToI. 2019. Times of India, Nagpur Times, 26 September 2019.
- Udikeri S S, Kranthi K R, Patil S B, Khadi B M. 2011. Emerging pests of Bt cotton and dynamics of insect pests in different events of Bt cotton. Conference: 5<sup>th</sup> Asian Cotton Research and Development Network Meeting (ACRD), Lahore (Pakistan), DOI: 10.13140/RG.2.1.1478.0241.
- Udikeri S S, Kranthi K R, Patil S B, Khadi B M. 2012. Emerging pests of Bt cotton and dynamics of insect pests in different events of Bt cotton. Karnataka Journal of Agricultural Sciences 23(1): 153-156.
- Udikeri S S, Kranthi K R, Patil S B, Modagi S A, Vandal N B. 2010. Bionomics of mirid bug, *Creontiodes biseratense* (Distant.) and oviposition pattern in Bt cotton. Journal of Agricultural Sciences 23: 153-156.
- Uthamasamy S, Bharathi M, Abdul Kreem A. 1987. Insecticides induced occurrence of mealybug *Ferisia virgata* (Cockrell) on cotton. In: S. Jayaraj (ed.). Resurgence of Sucking Pests. Tamil Nadu Agricultural University, Coimbatore, pp. 214-216.
- Varma G. 1979. A new record of *Trichogrammatoidea* sp. Near *guamensis* Nagaraja (MS) [Trichogrammatidae: Hymenoptera] an egg parasitoid of *Earias* species. Cotton Development 8: 43.
- Varma H S, Patel R K. 2012. Biology of Red cotton bug (*D. Koenigii*) Agres. An international e- journal (2):148-156.
- Varshney R K. 1984. New records of host-plants and distribution of some coccids from India (Homoptera: Coccoidea). Bulletin of Zoological Survey of India 6(1-3):137-142.
- Varshney R, Ballal C R. 2017. Biological, morphological and life table parameters of the predator, *Geocoris ochropterus* Fieber (Hemiptera: Geocoridae), fed on *Sitotroga cerealella* (Olivier) eggs. Egyptian Journal of Biological Pest Control 27(2): 189-194.
- Venkatesan T, Poorani J, Murthy K S, Jalali S K, Ashok Kumar G, Lalitha Y, Rajeshwari R. 2018. Occurrence of Chrysoperla *Zastrowi arabica* Henry et al. (Neuroptera, Chrysopidae), a cryptic



- song species of Chrysoperla (carnea-group), in India. Journal of Biological Control 22(1): 143-147.
- Vennila S, Biradar V K, Sabesh M, Bambawale O M. 2007. Know Your Native Natural Enemies of Cotton Insect Pests. Crop Protection Folder Series.
- Vennila S, Prasad Y G, Prabhakar M, Rishi Kumar, Nagrare V S, Amutha, M, Dhara Jothi B, Agarwal M, Sreedevi G, Venkateswarlu B, Kranthi K R, Bambawale O M. 2011. Spatio-temporal distribution of host plants of cotton mealybug, *Phenacoccus solenopsis* Tinsley in India, Technical Bulletin No. 26, National Centre for Integrated Pest Management, New Delhi. pp. 50.
- Vennila S, Ramamurthy V V, Deshmukh A, Pinjarkar D B, Agarwal M, Pagar P C, Prasad Y G, Prabhakar M, Kranthi K R, Bambawale O M. 2010. A treatise on mealybugs of Central Indian cotton production system. Technical Bulletin no. 24, National Centre for Integrated Pest Management, New Delhi pp 39.
- Yousuf M, Ikram M, Faisal M. 2015. Current status of Indian *Trichogramma* spp. along with their distribution record and host range. Indian Forester 141(7): 806-812.

(Manuscript Received: August, 2021; Revised: December, 2021;  
Accepted: December, 2021; Online Published: February, 2022)  
Online published (Preview) in [www.entosocindia.org](http://www.entosocindia.org) Ref. No. e21162

Table 1. Arthropod pests (insects and mites) infesting cotton in India

S.No.	Common name	Scientific name	Pest status	Plant parts affected	Occurrence in geographical area/ region	Reference
<b>Order: Hemiptera</b>						
Family						
i) Aleyrodidae						
1.	Cotton whitefly	<i>Bemisia tabaci</i> (Gennadius)	Major	Leaves	All three zones	Mishra and Lambda 1929; Husain, 1931; Husain et al., 1936; Jayaraj et al., 1986; Sundaramurthy, 1992; Kranthi, 2015; Rishi et al., 2019
ii) Aphididae						
2.	Cotton aphid	<i>Aphis gossypii</i> (Glover)	Major	Terrestrial plant parts	All three zones	Lefroy, 1906; Ayyar, 1932; Kataria and Kumar, 2012; Nagrare et al., 2019; Singh and Gandhi, 2012
3.	Green peach aphids	<i>Myzus persicae</i> (Sulzer)	Minor	--do--	Gujarat	
iii) Capsidae						
4.	Capsid bug	<i>Ragnus flavomaculatus</i> Ball.	Minor	Leaves		Dastur et al., 1960
5.	Capsid bug	<i>Ragnus importunatus</i> D.	Minor	Leaves		Dastur et al., 1960
6.	Capsid bug	<i>Ragnus morosus</i> Ball.	Minor	Leaves		Dastur et al., 1960
iv) Cercopidae						
7.	Tube making cercopid	<i>Maxcharata ensifera</i> Dist.	Minor	Leaves		Dastur et al., 1960; Nair, 1975
8.	Tube making cercopid	<i>Maxcharata planitiae</i> Dist.	Minor	Leaves		Dastur et al., 1960
v) Cicadellidae						
9.	Leafhopper, Indian cotton jassid	<i>Amrasca biguttula biguttula</i> (Ishida)	Major	Leaves	All three zones	Lefroy, 1906; Pruthi, 1940; Husain, 1937; Abbas and Afzal, 1945
10.	Leafhopper	<i>Empoasca gossypii</i> Banks	Minor	Leaves		Dastur et al., 1960
11.	Leafhopper	<i>Empoasca kerry</i> var. <i>motti</i> Pruthi	Minor	Leaves		Pruthi, 1940
12.	Leafhopper	<i>Empoasca melongena</i> Pruthi	Minor	Leaves		Dastur et al., 1960
13.	Leafhopper	<i>Empoasca minor</i> Pruthi	Minor	Leaves		Dastur et al., 1960
14.	Leafhopper	<i>Empoasca notata</i> Mell.	Minor	Leaves		Dastur et al., 1960
15.	Leafhopper	<i>Empoasca punjabensis</i> Pruthi	Minor	Leaves		Pruthi, 1940
16.	Small green leafhopper	<i>Jacobiasca formosana</i> Dwok	Minor	leaves		Sohi, 1983
vi) Cerococcidae						
17.	Yellow cotton scale	<i>Cerococcus indicus</i> (= <i>hibisci</i> ) (Maskell)	Minor	leaves	North India	Fletcher, 1914; Dastur et al., 1960; Nair, 1975
vii) Coccidae						
18.	Cotton Scale	<i>Chionaspis</i> sp.	Minor	Leaves		Dastur et al., 1960
19.	Black scale	<i>Parasaissetia nigra</i> Nietner	Minor	Leaves	North India	Fletcher, 1914; Dastur et al., 1960
20.	White scale	<i>Pulvinaria maxima</i> Green	Minor	Leaves	North India	Dastur et al 1960
viii) Coreidae						
21.	Capsid bug	<i>Agraphopus orientalis</i> (Dist.)	Minor	Leaves		Dhawani, 2016

(contd.)

22.	Capsid bug	<i>Anoplocnemis phasianana</i> (F.)	Minor	Leaves	Dhawani, 2016
23.	Capsid bug	<i>Clavigralla horrens</i> Dohrn	Minor	Green bolls	Fletcher 1914; Dastur et al., 1960
24.	Capsid bug	<i>Corizus bengalensis</i> (Dall.)	Minor	Leaves	Dhawani, 2016
25.	Capsid bug	<i>Leptocoris hospes</i> (F.)	Minor	Green bolls	Dastur et al., 1960
26.	Capsid bug	<i>Leptocoris augur</i> (F.)	Minor	Green bolls	Dastur et al., 1960
27.	Capsid bug	<i>Lygaeus pandurus</i> Scop.	Minor	Green bolls	Dastur et al., 1960
28.	Capsid bug	<i>Serinetia augur</i> (F.)	Minor	Green bolls	Nair, 1975
	ix) Diaspididae				
29.	Serene scale	<i>Serenaspis minima</i> (Maskell) (= <i>Pinnaspis minor</i> )	Minor	Leaves, stem	Nair, 1975
	x) Eurybrachidae				
30.	Planthoppers	<i>Eurybrachys tomentosa</i> (F.)	minor	Leaves	Nair, 1975
31.	Plant hopper	<i>Eurybrachys tomentosa</i> (F.)	Minor	Leaves	Dastur et al., 1960
32.	Plant hopper	<i>Ricania fenestrata</i> (F.)	Minor	Leaves	Dastur et al., 1960
	xii) Lygaeidae				
33.	Seed bug	<i>Graptostethus servus</i> (F.)	Minor	Green & open bolls	Nair 1975; Dhawani 2016; Siva Kumar 2017
34.	Plant bug	<i>Lygaeus hospes</i> (F.)	Minor	All plant parts	Singh and Gandhi 2012
35.	Plant bug	<i>Lygaeus militaris</i> (F.)	Minor	All plant parts	Singh and Gandhi 2012
36.	Dusky cotton bug	<i>Oxyarenus hyalinipennis</i> (Costa)	Minor	leaves	Ananthakrishnan et al., 1982, Ram and Chopra, 1988; Sammaiah et al., 2012
37.	Dusky cotton bug	<i>Oxyarenus laetus</i> Kirby	Minor	leaves	Lefroy, 1906; Misra, 1921; Prasad, 1956
38.	Plant bug	<i>Spilostethus pandurus</i> Scopoli	Minor	Leaves	Fletcher, 1914; Nair, 1975
39.	Plant bug	<i>Spilostethus mesilentus</i> (Stal.)	Minor	Leaves	Nair, 1975
40.	Plant bug	<i>Spilostethus hospes</i> (F.)	Minor	Leaves	Nair, 1975
	xiii) Membracidae				
41.	Tree hopper	<i>Olinotus oneratus</i> Walker	Minor	Leaves & Stem	Dastur et al., 1960
42.	Tree hopper	<i>Oxyrhachis subjecta</i> (Walker)	Minor	Leaves & Stem	Dhawani, 2016
	xiv) Miridae				
43.	Mirid bug	<i>Campylomma livida</i> Reuter	Minor	Squares & tender bolls	Udikeri et al., 2011
44.	Indian cotton mirid bug	<i>Creontiades biserratense</i> (Distant)	Major	Squares & tender bolls	Patil et al., 2006; Surulivelu and Dhara Jothi 2007; Udikeri et al., 2010
45.	Tea Mosquito bug	<i>Helopeltis antonii</i> Sign.	Minor	Tender bolls	Puttarudriah, 1958
46.	Tea Mosquito bug	<i>Helopeltis bradyi</i> Waterhouse	Minor	Squares & tender bolls	Udikeri et al., 2012
47.	Tea Mosquito bug	<i>Helopeltis theivora</i> Waterhouse	Minor	Squares & tender bolls	Dhara Jothi et al., 2018
48.	Mirid bug	<i>Hyalopeplus lineifer</i> Walker	Minor	Squares & tender bolls	Udikeri et al., 2010, 2011
49.	Mirid bug	<i>Ragnus importunitas</i> Dist.	Minor	Cotton bolls	Nair, 1975

(contd.)

50.	Mirid bug	<i>Ragnus morosus</i> Ball.	Minor	Cotton bolls		Nair, 1975
51.	Mirid bug xv) Monophlebidae	<i>Ragnus flavomaculatus</i> Ball.	Minor	Cotton bolls		Nair, 1975
52.	Ber Mealybug	<i>Perissopneumon tamarindus</i> (Green)	Minor	All plant parts	Haryana	Nagrare et al., 2014a
	xvi) Pentatomidae					
53.	Stink bug	<i>Acrosternum hilare</i> Say	Minor	Buds, green bolls	Andhra Pradesh	Laxman et al., 2014a
54.	Painted bug	<i>Bagraada hilaris</i> (Burmeister)	Minor	Buds, green bolls	Punjab	Dhawan, 2016
55.	Shield bug	<i>Dolycoris indicus</i> Stal	Minor	Buds, green bolls		Nair, 1975
56.	Green stink bug	<i>Nezara viridula</i> Linnaeus	Minor	Buds, green bolls	All three zones	Dastur et al., 1960; Sharma and Pampapathy, 2006
57.	Shield bug xvii) Pseudococcidae	<i>Scutellera nobilis</i> (F.)	Minor	Buds, green bolls		Nair, 1975
58.	Malvastrum mealybug	<i>Ferrisia malvastra</i> (McDaniel)	Minor	All plant parts	North India	Vennila et al 2010
59.	Striped mealybug	<i>Ferrisia virgata</i> (Cockerell)	Minor	All plant parts	All three zones	Fletcher, 1914; Dastur et al 1960; Uthamasamy et al., 1987; Nagrare et al., 2011
60.	Pink hibiscus mealybug	<i>Maconellicoccus hirsutus</i> (Green)	Minor	All plant parts	Tamil Nadu	Dastur et al 1960; Varshney, 1984; Dhawan et al., 1980; Nagrare et al., 2009
61.	Spherical mealybug	<i>Nipaeococcus viridis</i> (Newstead)	Minor	All plant parts	Maharashtra, Karnataka	Nair 1975; Thomas and Ramamurthy, 2011; Nagrare et al 2011
62.	Spiked mealybug	<i>Nipaeococcus nipae</i> (Maskell)	minor	All plant parts	South india	Fletcher 1914
63.	Papaya mealybug	<i>Paracoccus marginatus</i> (Williams & Granara de Willink)	Major	All plant parts	Central & South zone	Dhara Jothi et al., 2009; Dhobi et al., 2014
64.	Mealybug	<i>Phenacoccus corymbatus</i> Green	Minor	All plant parts		Dastur et al., 1960
65.	Madeira mealybug	<i>Phenacoccus madeirensis</i> Green	Minor	All plant parts	South India	Shylesha and Joshi, 2012
66.	Cotton mealybug	<i>Phenacoccus solenopsis</i> Tinsley	Major	All plant parts	All three zones	Dhawan et al., 2009; Nagrare et al., 2009
67.	Mealybug	<i>Pseudococcus</i> sp.	Minor	All plant parts		Fletcher, 1919
68.	Mango mealybug xviii) Pyrrhocoridae	<i>Rastrococcus iceryoides</i> (Green)	Minor	All plant parts	Maharashtra, Tamil Nadu	Dastur et al., 1960; Nagrare et al., 2014; Dhobi et al., 2014
69.	Red cotton bug	<i>Dysdercus cingulatus</i> (F.)	Minor	Green & open bolls, seeds	All three zones	Lefroy, 1906; Pruthi, 1922; Sen, 1924
70.	Red cotton bug	<i>Dysdercus koenigii</i> (F.)	Minor	Green & open bolls, seeds	All three zones	Saxena, 1965; Varma and Patel, 2012
71.	Red cotton bug	<i>Dysdercus olivaceus</i> (F.)	Minor	Green & open bolls, seeds	Tamil Nadu	Dastur et al., 1960; Nair, 1975
72.	Red cotton bug	<i>Dysdercus similis</i> Freeman	Minor	Green & open bolls, seeds	Madhya Pradesh	Saxena and Yadav, 1982
73.	<b>Order: Thysanoptera</b> Family i) Thripidae Thrips	<i>Scirtothrips dorsalis</i> Hood	Minor	Leaves, flowers, squares, bolls	South India, Gujarat	Dastur et al., 1960; Singh and Gandhi, 2012

(contd.)



74.	Thrips	<i>Scirtothrips oligochaetus</i> (Karny)	Minor	Tender shoots	Tamil Nadu	Dastur et al., 1960	
75.	Melon Thrips	<i>Thrips palmi</i> Karny	Minor	Leaves, flowers, squares, bolls		Prema et al., 2018	
76.	Onion thrips	<i>Thrips tabaci</i> Lind.	Major	Leaves, flowers, squares, bolls	All three zones	Dastur et al., 1960; Singh and Sidhu, 1958; Sathe and Mithari, 2015	
	Chewing, biting & borers insects						
	<b>Order: Coleoptera</b>						
	Family i) Anthribidae						
77.	White weevil	<i>Araecerus fasciculatus</i> Deg.	Minor	Roots		Dastur et al., 1960	
78.	Auger beetle	<i>Sinoxylon sudanicum</i> Lesne	Minor	Stem & branches	South India	Ayyar 1941; Dastur et al., 1960	
79.	Pulse beetle	<i>Callosobruchus</i> spp.	Minor	Seed		Dhawan, 2016	
80.	iv) Buprestidae	<i>Sphenoptera gossypii</i> Cotes	Minor	Stem, branches	Rajasthan	Lefroy, 1906; Dastur et al., 1960	
81.	v) Cerambycidae	<i>Coelosterna spinator</i> (F.)	Minor	Stem	South India	Fletcher, 1914	
82.	Stem borer	<i>Alcidodes affaber</i> Aurivillius	Minor	Leaves & seed	Gujarat, South India	Subramanian, 1959; Patel et al., 1963; Thummaiah et al., 1975	
83.	Shoot weevil	<i>Alcidodes fabrici</i> (F.)	Minor	Bark, stem & branches	Tamil Nadu	Dastur et al., 1960	
84.	Stem weevil	<i>Alcidodes leopardus</i> Oliv.	Minor	Bark, stem & branches	Tamil Nadu	Fletcher, 1914; Dastur et al., 1960	
85.	Stem weevil	<i>Alcidodes mysticus</i> Faust.	Minor	Bark, stem & branches	Tamil Nadu	Dastur et al., 1960	
86.	Flower weevil	<i>Amorphoidea arcuata</i> M.A.	Minor	Flowers, grown up bolls	North India	Dastur et al., 1960	
87.	Boll weevil	<i>Anthonomus</i> sp.	Minor	Leaves & seed	Tripura, West Bengal	Saha and Mitra, 2016	
88.	Green weevil	<i>Astycus lateralis</i> (F.)	Minor	Leaves		Lefroy, 1906; Dastur et al., 1960	
89.	Blackish grey weevil, Dark brown weevil	<i>Atactogaster finitimus</i> Faust	Minor	Seedling, bark & stem	Tamil Nadu	Fletcher, 1914	
90.	Stem weevil	<i>Episomus lacerta</i> (F.)	Minor	Bark, stem & branches	Tamil Nadu	Dastur et al., 1960	
91.	Black weevil	<i>Lepropus lateralis</i> (F.)	Minor	„		Lefroy, 1906; Dastur et al., 1960	
92.	Grey weevil	<i>Myllocerus blandus</i> Fst.	Minor	Cotton seedling		Dastur et al., 1960	
93.	Brown weevil	<i>Myllocerus discolor</i> Boheman	Minor	Leaves & seed	Karnataka, Tamil Nadu	Nair 1975, Kotikal and Math, 2016; Sahayaraj et al., 2016	
94.	Weevil	<i>Myllocerus laetivirens</i> Mshl.	Minor	Leaves	Delhi	Dastur et al., 1960	
95.	Cotton grey weevil, Ash weevil	<i>Myllocerus maculosus</i> Desbrochers	Minor	Leaves & seed	Tamil Nadu	Lefroy, 1906; Ponnuswami and Ramaswamy, 1975	

(contd.)

96.	Brown weevil	<i>Myloccerus sabulosus</i> (Mshll.)	Minor	Leaves	Dastur et al., 1960
97.	Weevil	<i>Myloccerus transmarinus</i> Hbst.	Minor	Leaves	Dastur et al., 1960
98.	Brown weevil	<i>Myloccerus undecimpustulatus</i> var. <i>Maculosus</i> (Desbrocher)	Minor	Leaves	Dhawani, 2016
99.	Ash weevil	<i>Myloccerus viridanus</i> (F.)	Minor	Leaves & seeds	Kotikal and Math, 2016
100.	Brown weevil	<i>Neocleonus sannio</i> (Herbst)	Minor	Leaves	Dhawani, 2016
101.	Stem weevil	<i>Pempherulus affinis</i> Faust	Major	Bark, stem & branches	Lefroy, 1906; Ayyar, 1941; Parameswaran and Chelliah, 1984
102.	Stem weevil	<i>Phytoscaphus triangularis</i> (Olivier)	minor	Leaves	Nair, 1975
103.	Black weevil	<i>Tanymecus hipidus</i> Mshll.	Minor	Bark, stem & branches	Dastur et al., 1960
104.	Black weevil	<i>Tanymecus indicus</i> Faust	Minor	Bark, stem & branches	Dastur et al., 1960
105.	Black weevil	<i>Tanymecus princeps</i> Faust	Minor	Leaves & seed	Dastur et al., 1960; Saha and Mitra, 2016
106.	Black weevil	<i>Tanymecus sciurus</i> Dliv.	Minor	Bark, stem & branches	Dastur et al.: 1960
107.	vii) Chrysomelidae Beetle	<i>Colasposoma auripenne</i> Mot.	Minor	Leaves	Dastur et al., 1960
108.	The red pumkin beetle	<i>Aulacophora foveicollis</i> (Lucas)	Minor	Leaves	Lefroy, 1906
109.	viii) Galerucidae Black weevil	<i>Monolepta signata</i> Ol.	Minor	Roots, leaves	Dastur et al., 1960
110.	ix) Meloidae Blister beetle	<i>Mylabris indica</i> (Thunberg)	Minor	Floral buds & flowers	CICR, 2018
111.	Blister beetle	<i>Mylabris phalerata</i> Pallas	Minor	Floral buds & flowers	Shinde et al., 2017
112.	Blister beetle	<i>Mylabris pustulata</i> Thunberg	Minor	Floral buds & flowers	CICR, 2018
113.	Blister beetle	<i>Zonabris pustulata</i> Thunberg	Minor	Floral buds & flowers	Fletcher, 1914; Dastur et al., 1960
114.	x) Scarabaeidae Flower chafer beetle	<i>Chiloloba acuta</i> (Widemann)	Minor	Flowers	Siva Kumar, 2017
115.	Flower chafer beetle	<i>Oxycetonia versicolor</i> (F.)	Minor	Flowers	Naik et al., 2019
116.	xi) Tenebrionidae Black fungus beetle	<i>Alphitobius laevigatus</i> (F.)	Minor	Seeds	Dastur et al., 1960
117.	Stored grain beetle	<i>Palorus</i> spp.	Minor	Flowers	Dhawani, 2016
118.	<b>Order: Dermoptera</b> Family i) Anisolabididae Maritime earwig	<i>Anisolabis martima</i> (Bonelli)	Minor	Roots	Kiranmai and Sammaiah, 2018
119.	Earwig	<i>Anthomyia pulvallis</i>	Minor	Roots	Kiranmai and Sammaiah, 2018

(contd.)

120.	ii) Forficulidae Common earwig <b>Order: Diptera</b> Family i) Agromyzidae Serpentine leaf miner ii) Cecidomyiidae Flower bud maggot, gall midge of cotton iii) Chloropidae Fruit flies iv) Sarcophagidae Flesh fly Flesh fly <b>Order: Hymenoptera</b> Family i) Formicidae Ant	<i>Forficula auriculata</i> L.	Minor	Roots	Telangana	Kiranmai and Sammaiah, 2018
121.		<i>Liriomyza trifolii</i> (Burgess)	Minor	Leaves	All three zones	Arora et al., 2005
122.		<i>Dasineura (Contarinia) gossypii</i> Fletcher	Minor	Squares, buds Flowers	Karnataka, Maharashtra	Fletcher, 1914; Ayyar, 1932; Dastur et al., 1960; Chakraborty et al; 2015
123.		<i>Metopostigma sauteri</i> Becker	Minor	Green bolls	Gujarat	Nair, 1975
124.		<i>Sarcophaga carnaria</i> L.	Minor		Telangana	Kiranmai and Sammaiah, 2018
125.		<i>Sarcophaga bercae</i>	Minor		Telangana	Kiranmai and Sammaiah, 2018
126.		<i>Camponotus compressus</i> (F.)	Minor	Associated with <i>P. solenopsis</i>	Gujarat	Singh and Kumar, 2017
127.		<i>Dorylus labiatus</i> (Schukard)	Minor	Leaves, stem	Punjab	Dhawan, 2016
128.		<i>Lacius niger</i> (L.)	Minor	leaves	Telangana	Kiranmai and Sammaiah, 2018
129.		<i>Monomorium indicum</i> (Forel)	Minor	Leaves, stem	Punjab	Dhawan, 2016
130.		<i>Monomorium pharaonis</i> L.	Minor	Associated with <i>P. solenopsis</i>	Gujarat	Singh and Kumar, 2017
131.		<i>Solenopsis geminata</i> (F.)	Minor	Leaves	All three Zones	Fletcher, 1914; Dastur et al., 1960; Dhawan, 2016
132.		<i>Solonopsis invicta</i> Buren.	Minor	Leaves	All three Zones	Kiranmai and Sammaiah, 2018
133.		<i>Tapinoma melanocephalum</i> (F.)	Minor	Associated with <i>P. solenopsis</i>	Gujarat	Singh and Kumar 2017
134.		<i>Wasmania auropunctata</i> Roger	Minor	leaves	Telangana	Kiranmai and Sammaiah, 2018
135.		<i>Microtermes mycophagus</i> Desneux	Minor	Stem, roots	Gujarat	Singh and Gandhi 2012; Pardeshi et al., 2010
136.		<i>Microtermes obesi</i> Holmgren	Minor	Stem, roots	North zone, Gujarat	Dastur et al., 1960; Pardeshi et al., 2010; Channabasava and Borad, 2019
137.		<i>Odontotermes bhagwathi</i>	Minor	Stem, roots	Gujarat	Singh and Gandhi, 2012
138.		<i>Odontotermes guptai</i>	Minor	Stem, roots	Gujarat	Singh and Gandhi, 2012
139.		<i>Odontotermes obesus</i> (Rambur)	Minor	Stem, roots	North zone, Gujarat	Dastur et al. 1960; Pardeshi et al, 2010; Channabasava and Borad, 2019
140.		<i>Trinervitermes bififormis</i> Wasmann	Minor	Stem, roots	Uttar Pradesh	Talat et al., 2016
141.	<b>Order: Lepidoptera</b> Family i) Arctidae Black hairy caterpillar, Woolly bear moth	<i>Aloa lactinea</i> Gram	Minor	Leaves		Dastur et al., 1960

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142.	Red hairy caterpillar	<i>Amsacta albistriga</i> Walker	Minor	Cotton seedling	North, South India	Dastur et al., 1960; Nair, 1975; Atwal and Dhaliwal, 1997
143.	Red hairy caterpillar	<i>Amsacta moorie</i> Butler	Minor	Cotton seedling	Central zone	Dastur et al., 1960
144.	Cram hairy caterpillar	<i>Estigmene lacitinea</i> Cram.	Minor	Leaves	Gujarat	Nair, 1975; Singh and Gandhi 2012
145.	Black hairy caterpillar	<i>Pericalitia ricini</i> F.	Minor	Leaves	South Zone	Fletcher, 1914; Dastur et al., 1960; Atwal and Dhaliwal, 1997
146.	Bihar hairy caterpillar ii) Cassidae	<i>Spilosoma obliqua</i> Walker	Minor	Flowering phase	North zone	Lefroy, 1906; Dastur et al., 1960
147.	Red coffee borer iii) Cosmopterigidae	<i>Zeuzera coffeae</i> Nietner	Minor	Stem and branches	South Zone	Fletcher, 1914; Dastur et al., 1960
148.	False bollworm	<i>Anatrachyntis simplex</i> (Walsingham, 1891)	Minor	Cotton leaves & bolls	North Zone	Fletcher, 1914; Nair, 1975; Naresh and Balan, 1984
149.	The peach borer	<i>Dichocrocis punctiferalis</i> (Guenee)	Minor	Leaves		Dastur et al., 1960; Nair, 1975
150.	The cotton leaf folder	<i>Sylepta derogata</i> F.	Minor	Leaves	All three zones	Lefroy, 1906; Lal and Singh, 1953
151.	Tussock moth	<i>Psalis securis</i> Hübner,	Minor	Cotton leaves		Nair, 1975
152.	Tussock moth	<i>Lymantria ampla</i> Walker	Minor	Cotton leaves	West Bengal	Nair, 1975; Pramanik and Basu, 1975
153.	Pink bollworm	<i>Pectinophora gossypiella</i> (Saunders)	Major	Flowers, squares, bolls	All cotton growing states	Saunders, 1843; Lefroy, 1906; Ballard, 1923; Marlatt, 1918; Dutt and Patel, 1943; Naik et al., 2018; Fand et al., 2019
154.	vii) Lymantriidae Hairy caterpillar	<i>Euproctis fraterna</i> Moore	Minor	Leaves	North & South India	Fletcher, 1914; Dastur et al., 1960; Atwal and Dhaliwal, 1997
155.	Hairy caterpillar	<i>Euproctis lunata</i> Walker	Minor	Leaves		Dastur et al., 1960
156.	Hairy caterpillar	<i>Euproctis varians</i> Walker	Minor	Leaves		Dastur et al., 1960
157.	Hairy caterpillar	<i>Euproctis fraternal</i> Moore	Minor	Leaves		Dastur et al., 1960
158.	Hairy Caterpillar	<i>Porthesia xanthorrhoea</i> Koll.	Minor	Leaves		Dastur et al., 1960
159.	Leaf perforator	<i>Bucculatrix loxoptera</i> Meyrick	Minor	Leaves		Dastur et al., 1960; Arora et al., 2005
160.	ix) Noctuidae Cutworm	<i>Agrotis flammatra</i> Schiff.	Minor	Cotton seedling		Dastur et al., 1960
161.	Caterpillar	<i>Aconita graelsii</i> Feisth	Minor	Leaves		Fletcher 1914; Nair 1975
162.	Caterpillar	<i>Aconita intercepta</i> Guenee	Minor	Leaves		Nair, 1975
163.	Caterpillar	<i>Aconita malvae</i> Esper	Minor	Leaves		Nair, 1975
164.	Black Cutworm	<i>Agrotis ipsilon</i> (Hufnagel)	Minor	Seedlings, leaves	North zone	Nair, 1975; Arora et al., 2005; Dhawan, 2016
165.	Cutworm	<i>Agrotis segetum</i> Denis & Schiffermüller	Minor	Leaves		Nair, 1975
166.	Cutworm	<i>Agrotis spinifera</i> (Hubner)	Minor	Leaves		Nair, 1975
167.	Cutworm	<i>Agrotis flammtra</i> (Hubner)	Minor	Leaves		Nair, 1975

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168.	Semilooper	<i>Anomis flava</i> (F.)	Minor	Leaves	All India	Khan, 1956; Nair, 1975
169.	Semilooper	<i>Anomis fuvida</i> Guenee	Minor	Leaves		Dastur et al., 1960; Nair, 1975
170.	Semilooper	<i>Anomis graellsi</i> Fstsh	Minor	Leaves		Dastur et al., 1960
171.	Semilooper	<i>Anomis intersepta</i> Guenee	Minor	Leaves		Dastur et al., 1960
172.	Semilooper	<i>Anomis mahvae</i> Esper	Minor	Leaves	Central India	ICAR-CICR 2010
173.	Safflower caterpillar	<i>Condica capensis</i> (Guenee)	Minor	Leaves		Lefroy, 1906
174.	The Abutilon moth	<i>Cosmophila erosa</i> Hub.	Minor	Leaves		Lefroy, 1906; Fletcher, 1914; Deshpande and Nadkarny, 1936; Singh and Gandhi, 2012
175.	Spiny bollworm	<i>Earias insulana</i> (Boisduval)	Minor	Flowers, squares, buds & shoots	All three zones	Lefroy, 1906; Fletcher, 1914; Deshpande and Nadkarny, 1936; Ahmad and Ullah, 1939
176.	Spotted bollworm	<i>Earias vitella</i> (F.)	Major	Flowers, squares, bolls, buds & shoots	All three zones	Lefroy, 1906; Fletcher, 1914; Deshpande and Nadkarny, 1936; Ahmad and Ullah, 1939
177.	Cutworm	<i>Euxoa segetum</i> Schiff.	Minor	Seedling		Dastur et al., 1960
178.	Cutworm	<i>Euxoa spinifera</i> Kb.	Minor	Cotton seedling		Dastur et al., 1960
179.	American bollworm	<i>Helicoverpa armigera</i> (Hubner)	Major	Flowers, squares, bolls	All cotton growing states	Ballard, 1920; Ayyar, 1932; Maheswariah and Puttarudriah, 1956; Dutt and Patel, 1943
180.	Lesser leaf worm	<i>Laphygma exigua</i> Hb.	Minor	Leaves, seedling		Dastur et al., 1960
181.	Leaf worm	<i>Ochropleura flammatrix</i> Schiff.	Minor	Leaves		Nair, 1975
182.	Leaf worm	<i>Mocis undata</i> (F.)	Minor	Leaves		Dastur et al., 1960
183.	Semilooper	<i>Pardoxia graellsi</i> Feisthamel	Minor	Leaves	South India	David and Ramamurthy, 2017
184.	Red bollworm	<i>Rabita frontalis</i> Walker	Minor	Leaves, green bolls	South India, Gujarat	Rao, 1924; Dastur et al., 1960
185.	Beet armyworm	<i>Spodoptera exigua</i> Hubner	Minor	Leaves	North zone	Nair, 1975; Rishi et al., 2010; Shashank et al., 2015
186.	Fall armyworm	<i>Spodoptera frugiperda</i> Smith	Minor	Bolls, flower, leaves	Maharashtra	Tol, 2019; F and et al., 2019
187.	African Cotton Leaf worm	<i>Spodoptera littoralis</i> Boisduval	Minor	Leaves	Gujarat	Singh and Gandhi, 2012
188.	Tobacco caterpillar	<i>Spodoptera litura</i> (F.)	Major	Leaves	South India	Dastur et al., 1960; Arora et al., 2007
189.	Semilooper	<i>Spodoptera pecten</i> Gn.	Minor	Leaves		Dastur et al., 1960
190.	Semilooper	<i>Tarache basifera</i> Walker	Minor	Leaves	Tamil Nadu	Nair, 1975; Shelker and Regupathy, 2007
191.	Semilooper	<i>Tarache marmoralis</i> (F.)	Minor	Leaves		Lefroy, 1906; Dastur et al., 1960; Nair, 1975
192.	Semilooper	<i>Tarache nitidula</i> (F.)	Minor	Leaves	Tamil Nadu	Fletcher, 1914; Shelker and Regupathy, 2007
193.	Semilooper	<i>Tarache notabilis</i> Walker	Minor	Leaves	Tamil Nadu, Maharashtra	Dastur et al., 1960; Nair, 1975
194.	Semilooper	<i>Tarache opalinoides</i> Guenee	Minor	Leaves	Tamil Nadu	Fletcher, 1914; Nair, 1975; Shelker and Regupathy, 2007
195.	x) Gracilariidae Leaf miner xi) Pyralidae	<i>Lithocolletis triaracha</i> Meyr.	Minor	Leaves		Dastur et al., 1960
196.	Rice mealworm	<i>Corcyra cephalonica</i> Stainton	Minor	Seeds	Chhattisgarh	Bhardwaj et al., 2017
197.	Pumpkin caterpillar	<i>Diaphania indica</i> Saunders	Minor	Leaves	South India	Hampson, 1896

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198.	Bud moth	<i>Phycita infusella</i> Meyrick	Minor	Buds & shoots	Gujrat, North India	Lefroy, 1906; Deshpande and Nadkarny, 1936; Atwal and Dhaliwal, 1997
	xii) Tineidae					
199.	Red coffee borer	<i>Acrocercops zYGONOMA</i> Meyr	Minor	Stem & branches		Dastur et al., 1960
200.	Fire colored beetle	<i>Pyroderces gossypiella</i> Snellen	Minor	Open bolls		Nair, 1975
	<b>Order: Orthoptera</b>					
	Family i) Acrididae					
201.	Grass hopper	<i>Acrida exaltata</i> Wilk.	Minor	Leaves		Dastur et al., 1960
202.	The black spotted grasshopper	<i>Acridium aeruginosum</i> Burmeister	Minor	Leaves		Lefroy, 1906
203.	Surface grasshopper	<i>Ailopus tumulus</i> (F.)	Minor	Cotton seedling		Dastur et al., 1960
204.	Grasshopper	<i>Ailopus thalassinus</i> (F.)	Minor	Leaves		Dhawan, 2016
205.	Surface grasshopper	<i>Atractomorpha crenulata</i> (F.)	Minor	Cotton seedling	All three zones	Srinivasan and Prabakar, 2013
206.	Large brown cricket	<i>Catantops annexus</i> Bol.	Minor	Leaves		Dastur et al., 1960
207.	Grasshopper	<i>Catantops pinguis innotabilis</i> (Walker)	Minor	Cotton flowers	All growing states	Mandal et al., 2007
208.	Dusky groundhopper	<i>Chrotogonus brachypterus</i> (Blanch.)	Minor	Cotton seedling		Dastur et al., 1960
209.	Dusky groundhopper	<i>Chrotogonus oxypterus</i> (Blanch.)	Minor	Cotton seedling		Dastur et al., 1960
210.	Dusky groundhopper	<i>Chrotogonus saussurei</i> Boll.	Minor	Cotton seedling		Dastur et al., 1960
211.	Dusky groundhopper	<i>Chrotogonus trachypterus</i> (Blanchard)	Minor	Cotton flowers	All growing states	Nair, 1975; Srinivasan and Prabakar, 2013; Mandal et al., 2007
212.	Grasshopper	<i>Cryptacanthaeris ranacea</i> Stal	Minor	Cotton seedling	North India	Fletcher, 1914; Atwal and Dhaliwal, 1997
213.	Grasshopper	<i>Cryptacanthaeris rosae</i>	Minor	Cotton seedling		Dastur et al., 1960
214.	Grasshopper	<i>Hieroglyphus nigrorepletus</i> (Bolivar)	Minor	Cotton flowers	Maharashtra	Shinde et al., 2017
215.	Grasshopper	<i>Melanoplus</i> sp.	Minor	Cotton parts	Andra Pradesh	Laxman et al., 2014b
216.	Grasshopper	<i>Oxya hyla hyla</i> (Serville)	Minor	Leaves		Dhawan, 2016
217.	Rice field grasshopper	<i>Oxya velox</i> (F.)	Minor	Leaves	All three zones	Dastur et al., 1960
218.	Ak grasshopper	<i>Poecilocerus pictus</i> (F.)	Minor	Leaves		Dhawan, 2016
219.	Desert locusts	<i>Shistocerca gregaria</i> Fst.	Minor	Leaves	Gujarat	Dastur et al., 1960, Singh and Gandhi, 2012
220.	Grasshopper	<i>Xenocatantops karnyi</i> Kirby	Minor	Flowers	All three zones	Srinivasan and Prabhakar, 2013
	ii) Gryllaeridae					
221.	Sword-tail crickets	<i>Trigonidium humbertianum</i> (Saus)	Minor	Leaves		Dhawan, 2016
	iii) Gryllidae					
222.	Large brown cricket	<i>Brachytrypes potentosus</i> (Lichtenstein)	Minor	Sedding	All three zones	Dastur et al., 1960
223.	Field cricket	<i>Brachytrypes achatinus</i> (Stoll.)	Minor	Sedding		Nair, 1975
224.	Field cricket	<i>Brachytrypes tomentosus</i> (Licht)	Minor	Sedding		Nair, 1975
225.	House cricket	<i>Achata domestica</i>	Minor	Sedding	Telangana	Kiranmai and Sammaiah, 2018
226.	Black-headed cricket tid	<i>Gryllulus domesticus</i> L.	Minor	Sedding		Dastur et al., 1960
227.	Field cricket	<i>Gryllus mitratus</i> H. Burmeister	minor	Sedding		Nair, 1975
228.	Fall field cricket	<i>Gryllus pennsylvanicus</i>	Minor	Sedding, leaves	Telangana	Kiranmai and Sammaiah, 2018

(contd.)

229.	Tropical house cricket	<i>Gryllus sagittatus</i>	Minor	Sedding, leaves	Telangana	Kirammai and Sammaiah, 2018
230.	Cricket tid	<i>Gryllus viator</i> Kirby	Minor	Sedding, leaves		Dastur et al., 1960
231.	Field cricket	<i>Gymnogyllus</i> spp.	Minor	Sedding, leaves	All cotton growing states	Dhawan, 2016
	iv) Pyrogomorphidae					
232.	Deccan grasshopper	<i>Colemania sphenarioides</i> Bolivar	Minor	Flowers	All three zones	Mandal et al., 2007
	v) Tettigoniidae					
233.	Bush cricket	<i>Elimaea nigropunctata</i> (Br.W.)	Minor	Leaves		Dhawan, 2016
	<b>Non-insect pests</b>					
	Order: Acarina					
	Family i) Eriophyidae					
234.	Wolly Mite	<i>Aceria gossypii</i> (Banks)	Minor	Leaves	All three zones	Nair, 1975; Gupta, 1985
235.	Mite	<i>Aceria puttarudriahi</i> Channabasavanna	Minor	Leaves	Karnataka, West Bengal	Channabasavanna, 1966
236.	Cotton Blister mite	<i>Eriophyes gossypii</i> Banks	Minor	Leaves	All India	Misra, 1920; Thakar and Desai 1929; Jhaveri, 1921
	ii) Erythraeidae					
237.	Mite	<i>Sphaerolophus delhiensis</i> (Khot)	Minor	Leaves	West Bengal	Gupta, 1985
	iii) Phytoseiidae					
238.	Mite	<i>Amblyseius alstoniae</i> (Gupta)	Minor	Leaves	West Bengal	Gupta, 1975
239.	Mite	<i>Typhlodromus fleschneri</i> Chant	Minor	Leaves	West Bengal	Chant, 1960; Gupta, 1977; Gupta, 1987
	iv) Tarsonemidae					
240.	Yellow mite / Broad mite	<i>Polyphagotarsonemus latus</i> Banks	Minor	Leaves	All three zones	Nair, 1975; Gupta, 1985
	v) Tenuipalpidae					
241.	Mite	<i>Raoiella indica</i> (Hirst)	Minor	Leaves	West Bengal	Gupta, 1985
	vi) Tetranychidae					
242.	Texas Citrus Mite	<i>Eutetranychus banksi</i> (McGregor)	Minor	Leaves	South Zone	Dastur et al., 1960
243.	Oriental red mite	<i>Eutetranychus orientalis</i> (Klein)	Minor	Leaves	All three zone	Gupta, 1985; CABI, EPPO, 2007.
244.	Yellow Tea-mite	<i>Hemitarsonemus latus</i> (Banks)	Minor	Leaves	Karnataka	Channabasavanna and Puttarudriah, 1959
245.	Red mite	<i>Tetranychus bioculatus</i> (Wood-Mason)	Minor	Leaves		Misra, 1913; Nair, 1975
246.	Red spider mite	<i>Tetranychus Cinnabarinus</i> Boisd.	Minor	Leaves	West Bengal	Gupta, 1985
247.	Mite	<i>Tetranychus lombardii</i> Baker & Pritchard	Minor	Leaves	West Bengal	Gupta, 1985
248.	Spider mite	<i>Tetranychus macfarlanei</i> Baker & Pritchard	Minor	Leaves	Gujrat	Jose and Shah, 1989 Jose et al., 1989
249.	Spider mite	<i>Tetranychus neocaledonicus</i> Andre	Minor	Leaves	Central & South Zone, West Bengal	Nair, 1975; Gupta, 1985
250.	Red mite	<i>Tetranychus telarius</i> L.	Minor	Leaves		Cherian, 1938; Dastur et al., 1960
251.	Red spider mite	<i>Tetranychus urticae</i> (Koch)	Minor	Leaves	North India	Nair, 1975; Dhawan, 2016

Table 2. Predators associated with arthropod pests of cotton in India

S. No.	Name of predator	Scientific name	Host insects	Geographical area	References
<b>Order: Coleoptera</b>					
Family i) Coccinellidae					
1.	Three striped lady beetle	<i>Brumoides suturalis</i> (F.)	Generalist predator	Tamil Nadu	Siva Kumar, 2017
2.	Lady bird beetle	<i>Brumus</i> sp.	Whitefly <i>B. tabaci</i>		Husain and Trehan, 1933
3.	Zigzag spotted lady bird beetle	<i>Cheilomenes sexmaculata</i> (F.)	Generalist predator	Andhra Pradesh, Panjab, Tamil Nadu	Nagrare et al., 2011; Aggarwal and Neetan, 2014; Routray et al., 2016
4.	Seven spotted ladybird beetle	<i>Coccinella septempunctata</i> L.	Generalist predator	Uttar Pradesh	Omkar and Pervez, 2002
5.	Transverse ladybird or transverse lady beetle	<i>Coccinella transversalis</i> F.	Generalist predator	Tripura, West Bengal, Tamil Nadu	Saha and Mitra, 2016; Siva Kumar, 2017
6.	Lady bird beetle	<i>Coccinella undecimpunctata</i> L.	Generalist predator		Khan, 1940
7.	Lady bird beetle	<i>Coelophora bisseolata</i> Mulsant	<i>A. gossypii</i>		Dastur et al., 1960
8.	The Australian lady bird beetle	<i>Cryptolaemus montrouzieri</i> Mulsant	Generalist predator	Gujarat, North India	Nagrare et al., 2011; Dumaniya et al., 2015; Fand et al., 2010
9.	Lady bird beetle	<i>Harmonia</i> sp	<i>P. solenopsis</i>	South Zone	Bharathi and Muthukrishnan, 2017
10.	Lady bird beetle	<i>Hippodamia variegata</i> Goeze	<i>P. solenopsis</i>	Haryana	Kedar et al., 2011
11.	Lady bird beetle	<i>Hyperaspis maindroni</i> Sicard	<i>P. solenopsis</i>	South Zone	Nair, 1975; Fand et al., 2010b, Sankar et al., 2011
12.	Lady bird beetle	<i>Micraspis discolor</i> (F.)	Generalist predator	Uttar Pradesh, Tamil Nadu	Omkar and Pervez, 2001; Siva Kumar, 2017
13.	Lady bird beetle	<i>Nephus regularis</i> (Sicard)	Generalist predator	North India, Madhya Pradesh	Nagrare et al., 2014; Fand et al., 2010; Rawat and Modi, 1969
14.	Lady bird beetle	<i>Pullus quadrilum</i> (Motschulsky)	<i>A. gossypii</i>		Dastur et al., 1960
15.	Lady bird beetle	<i>Pullus guimei</i> Mulsant	<i>A. gossypii</i>		Dastur et al., 1960
16.	Lady bird beetle	<i>Pullus xerampelinus</i> Mulsant	<i>A. gossypii</i>		Dastur et al., 1960
17.	Vedalia beetle	<i>Rodolia cardinalis</i> (Mulsant)	Generalist predator	Tamil Nadu	Siva Kumar, 2017
18.	Lady bird beetle	<i>Rodolia fumida</i> Mulsant	Generalist predator	North India, Tamil Nadu	Nagrare et al., 2011; Siva Kumar, 2017
19.	Lady bird beetle	<i>Scymnus coccivora</i> Ayyar	Generalist predator	North India	Fand et al., 2010
20.	Lady bird beetle	<i>Scymnus nublilis</i> Mulsant	<i>Phenacoccus corymbatus</i>		Dastur et al., 1960
21.	Lady bird beetle	<i>Scymnus</i> sp	<i>A. gossypii</i>		Dastur et al., 1960
22.	Lady bird beetle ii) Staphylinidae	<i>Serangium parcesetosum</i> Sicard	Whitefly	Punjab	Natrajan, 1990; Sangha et al., 2018
23.	Rove beetle	<i>Paederus fuscipes</i> (Curtis)	<i>B. tabaci</i>	South Zone	Natrajan, 1990
<b>Order: Neuroptera</b>					
i) Crysoptidae					
24.	Lace wings	<i>Chrysoperla zastrowi arabica</i> (Esben-Peterson)	Generalist predator of soft bodied insects	All three zones	Chakraborty and Korat, 2009; Gautam et al., 2009; Venkatesan et al., 2008
25.	Lace wings	Synonym <i>Chrysoperla carnea</i> <i>Chrysoperla cymbal Banks</i>	<i>A. biguttula biguttula</i>		Nasir, 1947

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26.	Lace wings	<i>Chrysoperla fasciata</i>	<i>A. biguttula biguttula</i>	Nasir, 1947
27.	Lace wings	<i>Chrysoperla afasciata</i>	<i>A. biguttula biguttula</i>	Nasir, 1947
28.	Lace wings	<i>Chrysoperla</i> sp.	<i>B. tabaci</i> , <i>A. gossypii</i>	Husain and Treha, 1933; Dastur et al., 1960
29.	Mallada	<i>Mallada desjardinsi</i> (Navas)	Aphids, thrips, whiteflies, mites	Mohapatra, 2004, Shimde et al., 2017
30.	Mallada	Mallada astur (Banks)	Aphid	Nimbalkar, 2007
31.	Mallada ii) Hemerobiidae	<i>Mallada boninensis</i> (Okamoto)	Whitefly	Joshi and Yadav, 1990
32.	Brown lace wing	<i>Hemerobius</i> sp.	<i>A. gossypii</i>	Dastur et al., 1960
33.	<b>Order: Diptera</b> Family i) Asilidae	<i>Philodictus femoralis</i> (Ricardo)	Cutworms & grubs	Dhawan, 2016
34.	Robber fly ii) Cecidomyiidae	<i>Diadiplosis indica</i> Felt	<i>P. corymbatus</i>	Dastur et al., 1960
35.	Midge fly iii) Chamaemyiidae	<i>Leucopis griseola</i> Fall.	<i>A. gossypii</i>	Dastur et al., 1960
36.	Aphid fly	<i>Leucopis nigricornis</i> Egger	<i>A. gossypii</i>	Dastur et al., 1960
37.	Aphid fly	<i>Leucopis luteicornis</i> Mal. Egger	<i>P. maxima</i>	Nair, 1975
38.	Drosophilidae Drosophilid predator v) Syrphidae	<i>Cacoxenus perspicax</i> (Knab)	Mealybugs	Nagrare et al., 2014
39.	Hover fly	<i>Eupeodes confrater</i> (Wiedemann)	Aphids	Khan 1940; Mitra et al., 2015
40.	Hover fly	<i>Syrphus baleatus</i> (De Geer)	Aphids	Khan, 1940
41.	Hover fly	<i>Syrphus serarius</i> Wied.	<i>A. gossypii</i>	Dastur et al., 1960
42.	Hover fly	<i>Eristalis quinquestratus</i> (F.)	Aphid	Dhawan, 2016
43.	Hover fly	<i>Ischiodon scutellaris</i> (F.)	Aphid	Mohapatra, 2004
44.	Hover fly	<i>Eristalinus aequalis</i> (Adams)	Aphid	Siva Kumar, 2017
45.	Hover fly	<i>Paragus serratus</i> F.	Aphid	Khan, 1940
46.	Hover fly	<i>Sphaerophoria javana</i> Wied.	<i>A. gossypii</i> , <i>F. virgata</i>	Dastur et al., 1960; Nair, 1975
	<b>Order: Hemiptera</b> Family i) Anthocoridae			
47.	Pirates bug	<i>Orius</i> spp.	Whitefly	Sahayaraj, 2004
48.	Pirate bug	<i>Orius tantillus</i> (Motschulsky)	<i>T. tabaci</i> , <i>S. orsalis</i>	Ballal et al., 2018
49.	Anthocorid bug	<i>Triphleps pectinophorae</i>	<i>P. gossypiiella</i>	Nagpal, 1948; Nair, 1975
50.	Anthocorid bug ii) Geocoridae	<i>Triphleps tantillus</i> Motsch.	<i>O. laetus</i> , <i>O. hyalipennis</i>	Mitra, 1921; Nair, 1975
51.	Big eyed bug	<i>Geocoris biocolor</i>	<i>B. tabaci</i>	Nimbalkar, 2007
52.	Big eyed bug	<i>Geocoris erythrocephalus</i> (Lepeletier & Serville)	Generalist predator	Siva Kumar, 2017
53.	Big eyed bug	<i>Geocoris ochropterus</i> (Fieber)	Generalist predator	Varshney and Ballal, 2017
54.	Big eyed bug	<i>Geocoris</i> sp.	<i>B. tabaci</i>	Sangha et al., 2018

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	iii) Miridae							
55.	Mirid bug	<i>Deracoris indianus</i>	<i>B. tabaci</i>	Tamil Nadu	Natrajan, 1990			
56.	Mirid bug	<i>Zanchilus breviceps</i> (Wagner)	<i>B. tabaci</i>	Punjab	Sangha et al., 2018			
	iv) Pentatomidae							
57.	Pentatomid bug	<i>Eocanthecona furellata</i> (Wolff)	Generalist predator	Odisha, Central India	Nair, 1975; Mohapatra, 2004; Vennila et al., 2007			
	v) Pyrrhocoridae							
58.	Red bug	<i>Antilochus coqueberti</i> F.	<i>Dysdercus</i> spp.	South Zone	Dastur et al., 1960			
	vi) Reduviidae							
59.	Reduviid bug	<i>Ectomocoris tibialis</i> Distant	<i>D. cingulatus</i> ,	Tamil Nadu	Subramanian and Kitherian, 2012			
60.	Reduviid bug	<i>Harpactor costalis</i> Stal.	<i>D. cingulatus</i> ,	Nair, 1975				
61.	Reduviid bug	<i>Rhynocoris fuscipes</i> F.	Generalist predator	Tamil Nadu	Subramanian and Kitherian, 2012			
62.	Reduviid bug	<i>Rhynocoris tumarii</i> (Ambrose & Livingston)	Generalist predator	Tamil Nadu	Subramanian and Kitherian, 2012			
63.	Reduviid bug	<i>Rhynocoris longifrons</i> Stal	<i>General predator</i>	Tamil Nadu	Subramanian and Kitherian, 2012			
64.	Reduviid bug	<i>Rhynocoris marginatus</i> (F.)	Aphid, eggs & larva of	Tamil Nadu	Sahayaraj et al., 2016			
65.	Assassin bug	<i>Triphleps tantilus</i> Mots.	pink bollworm	Punjab	Khan, 1940			
66.	Assassin bug	<i>Zelus</i> spp.	Generalist predator	Punjab	Dhawani, 2016			
	<b>Order: Lepidoptera</b>							
	Family i) Lycaenidae							
67.	Apefly	<i>Spalgis epius</i> (Westwood)	Mealybugs	Karnataka	Nair, 1975; Dhara Jothi, 2009			
	ii) Noctuidae							
68.	Caterpillar	<i>Eublemma quadriineata</i>	<i>P. corymbatus</i>	Nair, 1975				
69.	Caterpillar	<i>Eublemma scitula</i> Ramb.	<i>S. nigra</i> , <i>P. maxima</i>	Dastur et al., 1960; Nair, 1975				
	<b>Order: Mantodea</b>							
	Family i) Mantidea							
70.	Indian flower mantis	<i>Creobrotator pictipennis</i>	Generalist predator	Punjab	Dhawani, 2016			
71.	European mantid	<i>Mantis religiosa</i> (L.)	Generalist predator	Punjab	Dhawani, 2016			
72.	Mantid	<i>Mantis</i> sp.		Maharashtra	Shinde et al., 2017			
	<b>Order: Hymenoptera</b>							
	Family i) Aphelinidae							
73.	Tiny parasitic wasp	<i>Eretmocerus</i> spp.	Whitefly	Punjab	Dhawani, 2016			
	ii) Formicidae							
74.	Common black ant	<i>Camponotus compressus</i> (F.)	Jassid	Punjab	Dhawani, 2016			
75.	Common black ant	<i>Camponotus sericeus</i> (F.)	Jassid	Punjab	Dhawani, 2016			
76.	Carpenter ants	<i>Camponotus</i> sp.	<i>A. biguttula biguttula</i>	Nagpal, 1948				
	iii) Scolitidae							
77.	Wasp	<i>Scolia</i> spp.	Scarabaeid larvae	Punjab	Dhawani, 2016			
	iv) Sphecidae							
78.	Wasp	<i>Cerceris instabilis</i> (Smith)	Generalist predator	Punjab	Dhawani, 2016			
79.	Wasp	<i>Chalybion bengalense</i> (Dahlborn)	Generalist predator	Punjab	Dhawani, 2016			
80.	Wasp	<i>Chlorion lobatum</i> (F.)	Generalist predator	Punjab	Dhawani, 2016			

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81.	Wasp	<i>Eumenes petiolata</i> F.	Earias spp	Nair, 1975
82.	Wasp	<i>Larra nigriventris</i> (Menon)	Generalist predator	Dhawan, 2017
83.	Wasp	<i>Sceliphron coromendalicum</i>	Generalist predator	Dhawan, 2016
84.	Wasp	<i>Sphex lobatus</i> F.	<i>B. achaitinus</i>	Nair, 1975
85.	Wasp	<i>Sphex subtruncatus</i> (Dahlbom)	Generalist predator	Dhawan, 2016
	v) Vespidae			
86.	Wasp	<i>Delta</i> sp.	<i>A. flava, H. armigera</i>	Mohapatra, 2004
87.	Yellow wasp	<i>Polistes olivaceus</i> (DeGeer)	Generalist predator	Dhawan, 2016
88.	Red wasp	<i>Vespa orientalis</i> (L.)	Generalist predator	Dhawan, 2016
	<b>Order: Odonata</b>			
	Family i) Libellulidae			
89.	Dragon fly	<i>Acisionia panorpoides</i>	Small insects	Dhawan, 2016
90.	Dragon fly	<i>Coenagrion puella</i> (L.)	Small insects	Dhawan, 2016
91.	Dragon fly	<i>Pantala flavescens</i> (F.)	Small insects	Dhawan, 2016
92.	Dragon fly	<i>Trithemis pallidineris</i> (Kirby)	Small insects	Dhawan, 2016
	<b>Order: Araneae</b>			
	Family i) Araneidae			
93.	Orb weaver spider	<i>Araneus inustus</i> (Koch)	Generalist predator	Dhawan, 2016
94.	Orb weaver spider	<i>Araneus inustus</i> (Koch)	Generalist predator	Siva Kumar and Xavier, 2017
95.	Orb weaver spider	<i>Argeope</i> sp.	Generalist predator	Mohapatra, 2004
96.	Orb weaver spider	<i>Argiope anasuja</i> (Thorell)	Generalist predator	Jeyaparvathi et al., 2013
97.	Orb weaver spider	<i>Argiope pulchella</i> Jäger & Praxaysombath	Generalist predator	Rajeswaran et al., 2005
98.	Orb weaver spider	<i>Cyrtophora ciccatorosa</i> (Simon)	Generalist predator	Jeyaparvathi et al., 2013
99.	Orb weaver spider	<i>Cyrtophora moluccensis</i> (Doleschall)	Generalist predator	Siva Kumar and Xavier, 2017
100.	Orb weaver spider	<i>Eriovixia excelsa</i> (Simon)	Generalist predator	Nagrare et al., 2015
101.	Orb weaver spider	<i>Gastracantha unguifera</i> (Tikader)	Generalist predator	Jeyaparvathi et al., 2013
102.	Orb weaver spider	<i>Neoscona lugubris</i> (Doleschall)	Generalist predator	Jeyaparvathi et al., 2013
103.	Orb weaver spider	<i>Neoscona theisi</i> (Walckenaer)	Generalist predator	Nagrare et al., 2015
	ii) Clubionidae			
104.	The sac spider	<i>Castianeira</i> sp.	Generalist predator	Rajewaran et al., 2005
105.	The sac spider	<i>Clubiona</i> sp.	Generalist predator	Rajewaran et al., 2005
	iii) Dictynidae			
106.	Web weaver spider	<i>Dictyna</i> sp.	Generalist predator	Siva Kumar and Xavier, 2017
	iv) Eutichuridae			
107.	Yellow sac spiders	<i>Cheiracanthium inclusum</i> (Hentz)	Generalist predator	Siva Kumar and Xavier, 2017
	v) Gnaphosidae			
108.	Ground spider	<i>Gnaphosa poonaensis</i> (Tikader)	Generalist predator	Jeyaparvathi et al., 2013
	vi) Lycosidae			
109.	Wolf spider	<i>Hippasa olivacea</i> (Thorell)	Generalist predator	Jeyaparvathi et al., 2013
110.	Wolf spider	<i>Hogna lenta</i> (Sundevall)	Generalist predator	Siva Kumar and Xavier, 2017

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111.	Wolf spider	<i>Hogna</i> sp.	Generalist predator	Tamil Nadu	Siva Kumar and Xavier, 2017
112.	Wolf spider	<i>Lycosa pseudoannulata</i> (Boesenberg & Strand)	Generalist predator	Tamil Nadu	Jeyaparvathi et al., 2013
113.	Wolf spider	<i>Rabidosia punctata</i>	Generalist predator	Telangana	Kiranmai and Sammaiah, 2018
114.	Wolf spider	<i>Schicosa saltatrix</i>	Generalist predator	Telangana	Kiranmai and Sammaiah, 2018
115.	vii) Oxyopidae				
115.	Lynx spider	<i>Hamatalwa</i> sp.	Generalist predator	Tamil Nadu	Siva Kumar and Xavier, 2017
116.	Lynx spider	<i>Oxyopes birmanicus</i> (Nona Yvette)	Generalist predator	Tamil Nadu	Jeyaparvathi et al., 2013
117.	Lynx spider	<i>Oxyopes birmanicus</i> (Thorell)	Generalist predator	Tamil Nadu	Mahalakshmi and Jeyaparvathi, 2014
118.	Lynx spider	<i>Oxyopes chitrae</i> Tikader	Generalist predator	Tamil Nadu	Sebastian et al., 2004
119.	Lynx spider	<i>Oxyopes heterophthalmus</i> (Latreille)	Generalist predator	Tamil Nadu	Siva Kumar and Xavier, 2017
120.	Lynx spider	<i>Oxyopes hindostanicus</i> (Pocock)	Generalist predator	Tamil Nadu	Jeyaparvathi et al., 2013
121.	Lynx spider	<i>Oxyopes javanus</i> (Koch)	Generalist predator	Tamil Nadu	Siva Kumar and Xavier, 2017
122.	Lynx spider	<i>Oxyopes lineatipes</i> (Koch)	Generalist predator	Punjab	Dhawan, 2017
123.	Lynx spider	<i>Oxyopes lineatipes</i> (Koch)	Generalist predator	Tamil Nadu	Siva Kumar and Xavier, 2017
124.	Lynx spider	<i>Oxyopes macilentus</i> (L.Koch)	Generalist predator	Tamil Nadu	Siva Kumar and Xavier, 2017
125.	Lynx spider	<i>Oxyopes pankaji</i> (Gajbe & Gajbe)	Generalist predator	Central India	Nagrare et al., 2015
126.	Lynx spider	<i>Oxyopes ramae</i> Tikader and Biswas	Generalist predator	Tamil Nadu	Rajeswaran et al., 2005
127.	Lynx spider	<i>Oxyopes salticus</i> (Hentz)	Generalist predator	Tamil Nadu	Siva Kumar and Xavier, 2017
128.	Lynx spider	<i>Oxyopes sunandae</i> (Tikader).	Generalist predator	Tamil Nadu	Siva Kumar and Xavier, 2017
129.	Lynx spider	<i>Oxyopes variabilis</i> (Koch)	Generalist predator	Tamil Nadu	Siva Kumar and Xavier, 2017
130.	Lynx spider	<i>Peucetia latikae</i> (Tikader)	Generalist predator	Tamil Nadu	Siva Kumar and Xavier, 2017
131.	Lynx spider	<i>Peucetia latikae</i> (Tikader)	Generalist predator	Tamil Nadu	Jeyaparvathi et al., 2013
132.	Lynx spider	<i>Peucetia viridana</i> (Stoliczk)	Generalist predator	Tamil Nadu	Siva Kumar and Xavier, 2017
133.	Lynx spider	<i>Peucetia viridana</i> (Stoliczka)	Generalist predator	Tamil Nadu	Jeyaparvathi et al., 2013
134.	viii) Parassidae				
134.	Huntsman spiders	<i>Olios</i> sp.		Tamil Nadu	Rajeswaran et al., 2005
135.	ix) Pisauridae				
135.	Fishing spider	<i>Thalassius albocinctus</i> (Dol.)	Generalist predator	Tamil Nadu	Jeyaparvathi et al., 2013
135.	x) Salticidae				
136.	Jumping Spider	<i>Bianor</i> sp. (Peckham & peckham)	Generalist predator	Central India	Nagrare et al., 2015
137.	Jumping Spider	<i>Marpissa decorata</i> (Tikader)	Generalist predator	Tamil Nadu	Jeyaparvathi et al., 2013
138.	Jumping Spider	<i>Marpissa thakuriensis</i> (Tikader)	Generalist predator	Tamil Nadu	Jeyaparvathi et al., 2013
139.	Jumping spider	<i>Pandisus indicus</i> (Proszynski)	Generalist predator	Tamil Nadu	Mahalakshmi and Jeyaparvathi, 2014
140.	Jumping spider	<i>Phidippus indicus</i> (Blackwall)	Generalist predator	Tamil Nadu	Jeyaparvathi et al., 2013
141.	Jumping spider	<i>Phidippus</i> sp.	Generalist predator	Punjab, Tamil Nadu	Dhawan, 2016; Siva Kumar and Xavier, 2017
142.	Jumping Spider	<i>Phintella vittata</i> (C.L.Koch)	Generalist predator	Central India	Nagrare et al., 2015
143.	Jumping Spider	<i>Phlegma</i> sp. (Simon)	Generalist predator	Central India	Nagrare et al., 2015
144.	Jumping Spider	<i>Plexippus paykulli</i> (Audoin)	Generalist predator	Tamil Nadu	Jeyaparvathi et al., 2013
145.	Jumping Spider	<i>Plexippus petersi</i> (Karsch)	Generalist predator	Tamil Nadu	Jeyaparvathi et al., 2013

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146.	Jumping spider	<i>Telamonia dimidiata</i> (Simon)	Generalist predator	Tamil Nadu	Jeyaparvathi et al., 2013
147.	Jumping spider	<i>Thanita phamoniansis</i> (Tikader)	Generalist predator	Tamil Nadu	Jeyaparvathi et al., 2013
148.	Jumping spider	<i>Thyene imperialis</i> (Rossi)	Generalist predator	Central India	Nagrare et al., 2015
149.	Jumping spider	<i>Distina albida</i> L.	<i>A. biguttula biguttula</i>		Nagpal, 1948
150.	xi) Sparassidae				
150.	Huntsman spider	<i>Olios milletii</i> (Pocock)	Generalist predator	Tamil Nadu	Jeyaparvathi et al., 2013
151.	xii) Tetragnathidae				
151.	Orb weaver spider	<i>Leucauge decorata</i> (Blackwall)	Generalist predator	Central India	Nagrare et al., 2015
152.	Orb weaver spider	<i>Metellina mengi</i> (Blackwall)	Generalist predator	Tamil Nadu	Siva Kumar and Xavier, 2017
153.	Orb weaver spider	<i>Opadometa fastigata</i> (Eugene Simon)	Generalist predator	Tamil Nadu	Mahalakshmi and Jeyaparvathi, 2014
154.	Orb weaver spider	<i>Tetragnatha maxillosa</i> (Thorell)			Dhawan, 2016
155.	Orb weaver spider	<i>Tetragnatha maxillosa</i> (Thorell)	Generalist predator	Tamil Nadu	Siva Kumar and Xavier, 2017
156.	xiii) Theridiidae				
156.	Cob web spider	<i>Latrodectus hasseltii indicus</i> Simon	Generalist predator	Gujrat	Siliwal and Kumar, 2001
157.	Cob web spider	<i>Romphaea</i> sp.	Generalist predator	Central India	Nagrare et al., 2015
158.	Cob web spider	<i>Theridula gonygaster</i> (Simon)	Generalist predator	Central India	Nagrare et al., 2015
159.	xiv) Thomisidae				
159.	Crab spider	<i>Cyrtophora moluccensis</i> (Doleschall)	Generalist predator	Tamil Nadu	Mahalakshmi and Jeyaparvathi, 2014
160.	Crab spider	<i>Diaea</i> sp. (Thorell)	Generalist predator	Central India	Nagrare et al., 2015
161.	Crab spider	<i>Lysiteles catulus</i> (Simon)	Generalist predator	Central India	Nagrare et al., 2015
162.	Crab spider	<i>Ozyptila praticola</i> (Koch)	Generalist predator	Tamil Nadu	Siva Kumar and Xavier, 2017
163.	Crab spider	<i>Thomisus cherapunjeus</i>	Generalist predator	Tamil Nadu	Rajeswari et al., 2005
164.	Crab spider	<i>Thomisus okinawensis</i> (Strand)	Generalist predator	Central India	Nagrare et al., 2015
165.	Crab spider	<i>Thomisus projectus</i> Tikader	Generalist predator	Central India	Nagrare et al., 2015
166.	Crab spider	<i>Thomisus</i> sp. (Walekenaer)	Generalist predator	Central India	Nagrare et al., 2015
167.	Crab spider	<i>Thomisus spectabilis</i> (Doleschall)	Generalist predator	Central India	Nagrare et al., 2015
168.	xv) Uloboridae				
168.	Wolf Spiders	<i>Uloborus khasiensis</i> Tikader	Generalist predator	Tamil Nadu	Rajeswari et al., 2005
	<b>Order: Acarina</b>				
	Family i) Phytoseiidae				
169.	Predatory mites	<i>Amblyseius alstoniae</i> (Gupta)	Spider mites	West Bengal	Gupta, 1975
170.	Predatory mites	<i>Amblyseius delhiensis</i> (Narayanan & Kaur)	<i>Eggs of Jassid</i>	West Bengal	Narayanan and Kaur, 1960; Somchoudhury, 1979; Gupta, 1985
171.	Predatory mites	<i>Amblyseius multidentatus</i> (Swirski & Shechter)	Eriophyid mites & Tetranychid mites	West Bengal	Gupta, 1985
172.	Predatory mites	<i>Amblyseius</i> spp.	Thrips, spider, mites		Dhawan, 2016
173.	Predatory mites	<i>Camspid</i> sp.	Thrips		Nair, 1975
174.	ii) Pyemotidae				
174.	Predatory mites	<i>Pediculoides ventricosus</i> (Newport)	<i>P. affinis</i>	South India	Nair, 1975

Table 3. Parasitoids/ parasites associated with arthropod pests of cotton pests in India

S. No.	Name of parasitoid/ Parasite	Scientific name	Host insects	Geographical area	References
<b>Order: Hymenoptera</b>					
Family i) Aphelinidae					
1.	Parasitoid wasp	<i>Aphelinus</i> sp.	<i>A. gossypii</i>	Central India	Vennila et al., 2007
2.	Parasitoid wasp	<i>Aphelinus mali</i> (Hald)	<i>A. gossypii</i>	Central India	Vennila et al., 2007
3.	Parasitoid wasp	<i>Aphelinus flavipes</i> (Forst.)	<i>A. gossypii</i>	Central India	Vennila et al., 2007
4.	Parasitoid wasp	<i>Coccophagus longifastatus</i> How.	<i>P. solenopsis</i>	Tamil Nadu	Sankar et al., 2011
5.	Parasitoid wasp	<i>Coccophagus</i> sp.	<i>P. solenopsis</i>	Tamil Nadu	Sankar et al., 2011
6.	Parasitoid wasp	<i>Encarsia formosa</i> (Gahan)	<i>B. tacaci</i>	Dhawan, 2016	Dhawan, 2016
7.	Parasitoid wasp	<i>Encarsia lutea</i> (Masi)	<i>B. tacaci</i>	Punjab	Sangha et al., 2018
8.	Nymphal parasitoid	<i>Encarsia shafeei</i> Hayat	<i>B. tacaci</i>	Tamil Nadu	Natarajan, 1990; Beevi and Balasubramanian, 1992
9.	Parasitoid wasp	<i>Encarsia sophia</i> (Girault & Dodd)	<i>B. tacaci</i>	Punjab	Sangha et al., 2018
10.	Nymphal parasitoid	<i>Eretmocerus mundus</i> Hayat	<i>B. tacaci</i>	Tamil Nadu	Natarajan, 1990
11.	Nymphal parasitoid	<i>Eretmocerus</i> spp.	<i>B. tacaci</i>	Dhawan, 2016	Dhawan, 2016
12.	Hyperparasitoid	<i>Myiocnema comperei</i> Ashmead	<i>P. solenopsis</i>	Haryana	Ram and Saini, 2010
13.	Hyperparasitoid	<i>Promuscidia unifasciiventris</i> Girault	on <i>A. bambawalei</i> , <i>Anagyrus</i> spp., etc.	Central India	Nagrare et al., 2011; Ram et al., 2009
ii) Braconidae					
14.	Larval parasitoid	<i>Agathias fibiae</i> Nixon	<i>E. vitella</i>	Punjab	Jagmohan, 2001
15.	Larval parasitoid	<i>Agathias</i> sp.	<i>E. vitella</i> , <i>P. gossypiella</i>	Punjab	Nimbalkar, 2007
16.	Larval parasitoid	<i>Agathias fabiae</i> Nixon	<i>E. vitella</i> , <i>P. gossypiella</i>	Tamil Nadu	Natarajan and Seshadri, 1988
17.	Egg-larval parasitoid	<i>Apanteles angaleti</i> (Muesebeck)	<i>P. gossypiella</i>	North India	Sekhon and Verma, 1983
18.	Egg-larval parasitoid	<i>Apanteles colemani</i> Vier.	<i>A. moorei</i>	Nair, 1975	Nair, 1975
19.	Egg-larval parasitoid	<i>Apanteles creatonoti</i> Vier.	<i>A. moorei</i>	Nair, 1975	Nair, 1975
20.	Egg-larval parasitoid	<i>Apanteles obliquae</i> Walker	<i>A. moorei</i>	South India	Cherian and Kylasam, 1941
21.	Egg-larval parasitoid	<i>Apanteles pectinophorae</i> Ayyar	<i>P. gossypiella</i>	Nimbalkar 2007	Nimbalkar 2007
22.	Egg-larval parasitoid	<i>Apanteles ruficornis</i> (Haliday)	<i>H. armigera</i>	Nair, 1975; Nimbalkar, 2007	Nair, 1975; Nimbalkar, 2007
23.	Egg-larval parasitoid	<i>Apanteles significans</i> (Wlk.)	<i>E. fraternus</i> , <i>H. armigera</i>	Cherian and Kylasam, 1941; Nair, 1975	Cherian and Kylasam, 1941; Nair, 1975
24.	Parasitoid	<i>Bassus</i> sp.	<i>Earias</i> spp.	Tamil Nadu	Nimbalkar, 2007
25.	Larval parasitoid	<i>Bracon brevicornis</i> Wesmæl	<i>E. vitella</i> , <i>P. gossypiella</i> , <i>H. armigera</i>	Nimbalkar, 2007	Nimbalkar, 2007
26.	Larval parasitoid	<i>Bracon chinensis</i> Szepietzi	<i>P. gossypiella</i>	Nimbalkar, 2007	Nimbalkar, 2007
27.	Larval parasitoid	<i>Bracon gelechia</i> Cameron	<i>P. gossypiella</i> , <i>H. armigera</i>	Thompson, 1946; Nair, 1975	Thompson, 1946; Nair, 1975
28.	Larval parasitoid	<i>Bracon greeni</i> Ashmead	<i>P. gossypiella</i> , <i>E. vitella</i> , <i>H. armigera</i>	Nair, 1975; Nimbalkar, 2007	Nair, 1975; Nimbalkar, 2007
29.	Larval parasitoid	<i>Bracon hebetor</i> Say	<i>E. vitella</i> , <i>P. gossypiella</i>	Nimbalkar, 2007	Nimbalkar, 2007
30.	Larval parasitoid	<i>Bracon kirpatricki</i> Wilkinson	<i>E. vitella</i>	North India	Nimbalkar, 2007
31.	Larval parasitoid	<i>Bracon kitcheneri</i> D&G	<i>E. vitella</i> , <i>P. gossypiella</i>	Nair, 1975; Nimbalkar, 2007	Nair, 1975; Nimbalkar, 2007

(contd.)



32.	Larval parasitoid	<i>Bracon lefroyi</i> Dudgeon & Gough	<i>E. vitella</i> , <i>P. gossypiella</i>	Central and North India	Nair, 1975; Jagmohan, 2001; Naik et al., 2018
33.	Larval parasitoid	<i>Camptolithipsis gossypiella</i>	<i>P. gossypiella</i>		Nimbalkar, 2007
34.	Larval parasitoid	<i>Camptolithipsis</i> sp.	<i>P. gossypiella</i>	North India	Sekhon and Verma, 1983
35.	Larval parasitoid	<i>Cedria paradoxa</i> Wilkinson	<i>S. derogata</i>		Nair, 1975
36.	Larval parasite	<i>Chelonus blackburni</i> Cameron	<i>P. gossypiella</i>	Haryana	Pawar et al., 1983
37.	Egg-larval parasitoid	<i>Chelonus heliopae</i> Gupta	<i>H. armigera</i> , <i>S. litura</i> , <i>Earias</i> spp.		Nair, 1975; Nimbalkar, 2007; Patel and Patel, 1971
38.	Egg-Larval parasite	<i>Chelonus narayani</i> Subba Rao	<i>P. gossypiella</i> , <i>H. armigera</i>		Nimbalkar, 2007
39.	Egg-larval parasite	<i>Chelonus rufus</i> Lyle	<i>Earias</i> spp.	Punjab	Nair, 1975
40.	Egg-larval parasitoid	<i>Chelonus</i> sp.	<i>P. gossypiella</i>	North India	Sekhon and Verma, 1983
41.	Larval parasitoid	<i>Cremastus</i> sp.	<i>S. derogata</i>		Nair, 1975
42.	Larval parasitoid	<i>Disophrys</i> sp.	<i>E. fraterna</i>		Nair, 1975
43.	Larval parasitoid	<i>Glyptomorpha pectoralis</i> (=smecenus) (Brulle)	<i>S. gossypii</i>		Nair, 1975
44.	Larval parasitoid	<i>Goniozus</i> sp.	<i>P. gossypiella</i> , <i>Earias</i> sp.	South India	Cherian and Kylasam, 1941; Nair, 1975; Nimbalkar, 2007
45.	Larval parasitoid	<i>Horminae</i> sp.	<i>S. gossypii</i>		Nair, 1975
46.	Parasitoid	<i>Megalomum</i> sp.	<i>P. maxima</i>		Dastur et al., 1960
47.	Larval parasitoid	<i>Microbracon gelechidiphagus</i> Rank.	<i>P. gossypiella</i>	South India	Cherian and Kylasam, 1941
48.	Larval parasitoid	<i>Microbracon lefroyi</i> D. & G.	<i>E. vitella</i>	Tamil Nadu	Ahmad and Ullah, 1939, Cherian and Kylasam, 1941
49.	Larval parasitoid	<i>Microbracon</i> sp.	<i>P. affinis</i>	South India	Ayyar, 1941
50.	Larval parasitoid	<i>Microbracon ramicola</i>	<i>S. derogata</i>		Nair, 1975
51.	Larval parasitoid	<i>Microbracon taclardiae</i> Cam.	<i>Earias</i> spp.		Nair, 1975
52.	Egg larval parasitoid	<i>Microchelonus chelonus</i> versatilis (Wilkinson)	<i>H. armigera</i>	North & Central India	Vennila et al., 2007
53.	Larval parasitoid	<i>Microplitis</i> sp.	<i>H. armigera</i>		Nimbalkar, 2007
54.	Larval parasitoid	<i>Patalodes gossypiellae</i> Mues	<i>P. gossypiella</i>		Muesebeck, 1956
55.	Larval parasitoid	<i>Perilitus</i> (Dimocampus) myloceri (Wilkinson)	<i>M. maculatus</i>		Nair, 1975
56.	Larval parasitoid	<i>Phanerotoma hendecasisella</i> Cam	<i>Earias</i> spp.		Nair, 1975
57.	Larval parasitoid	<i>Phanerotoma</i> sp.	<i>S. derogata</i>		Nair, 1975
58.	Larval parasitoid	<i>Rhaconotus</i> sp.	<i>P. affinis</i>	South India	Nair, 1975
59.	Larval parasitoid	<i>Rogas algharensi</i> (Qadri)	<i>E. vitella</i> , <i>P. gossypiella</i>	All three zones	Qadri, 1933; Cherian and Kylasam, 1941; Nair, 1975; Nimbalkar, 2007
60.	Larval parasitoid	<i>Rogas kanpurensis</i> Mani	<i>E. vitella</i>	Punjab	Jagmohan, 2001
61.	Larval parasitoid	<i>Rogas</i> sp.	<i>P. gossypiella</i>	North India	Sekhon and Verma, 1983
62.	Larval parasitoid	<i>Rogas testaceus</i> Spin.	Caterpillar	North & Central zone	Dastur et al., 1960

(contd.)

63.	Larval parasitoid	<i>Spathius critolaus</i> Nixon	<i>P. affinis</i> , <i>S. sudanicum</i>	South India	Ayyar, 1941
64.	Larval parasitoid	<i>Tetrastichus nyemitavus</i>	<i>P. gossypiella</i>		Nimbalkar, 2007
65.	Larval parasitoid	<i>Trioxys angelicae</i> (Haliday)	<i>F. virgata</i>		Nair, 1975
66.	Larval parasitoid iii) Chalcididae	<i>Vipio</i> sp.	<i>S. gossypii</i>		Nair, 1975
67.	Pupal parasitoid	<i>Aneristus ceroplasate</i> How.	<i>S. nigra</i> , <i>P. maxima</i>		Thompson, 1950; Nair, 1975
68.	Pupal parasitoid	<i>Anysis saissetiae</i> Ashm	<i>S. nigra</i> , <i>P. maxima</i>		Pruthi and Mani, 1940; Nair, 1975
69.	Pupal parasitoid	<i>Brachymeria euploeae</i> (Westw.)	<i>S. derogata</i>		Nair, 1975
70.	Pupal parasitoid	<i>Brachymeria lasus</i> Walker	<i>Earias</i> sp.		Nimbalkar, 2007
71.	Pupal parasitoid	<i>Brachymeria nephantidis</i> Gahan	<i>Earias</i> sp.	North India	Nimbalkar, 2007
72.	Pupal parasitoid	<i>Brachymeria nephantidis</i> Gahan	<i>E. vitella</i>		Sekhon and Verma, 1983; Jagmohan, 2001
73.	Pupal parasitoid	<i>Brachymeria nosatoi</i> Habu	<i>Earias</i> sp.		Nimbalkar, 2007
74.	Pupal parasitoid	<i>Brachymeria responsator</i> Walk	<i>E. vitella</i> , <i>H. armigera</i>	Punjab	Nair, 1975; Jagmohan, 2001; Nimbalkar, 2007
75.	Pupal parasitoid	<i>Brachymeria tachardiae</i> Cam.	<i>E. vitella</i> , <i>S. derogata</i>	Punjab	Dastur et al., 1960; Nair, 1975; Jagmohan, 2001
76.	Pupal parasitoid	<i>Brachymeria apantelesi</i>	<i>Earias</i> sp.		Nimbalkar, 2007
77.	Pupal parasitoid	<i>Brachymeria apantelesi</i> Risbec	<i>Earias</i> sp.		Nimbalkar, 2007
78.	Pupal parasitoid	<i>Brachymeria attevate</i>	<i>Earias</i> sp.		Nimbalkar, 2007
79.	Pupal parasitoid	<i>Centrochalcis rufescens</i>	<i>E. vitella</i>	Punjab	Jagmohan, 2001
80.	Pupal parasitoid	<i>Centrochalcis</i> sp.	<i>E. vitella</i>	Punjab	Dastur et al., 1960
81.	Larval parasitoid	<i>Chalcis tacharidae</i>	<i>E. vitella</i>	Punjab	Jagmohan, 2001
82.	Parasitoid	<i>Coccophagus longifasciatus</i> How.	<i>S. nigra</i>		Pruthi and Mani, 1940
83.	Parasitoid	<i>Eucepsis</i> sp.	<i>E. vitella</i>	Punjab	Jagmohan, 2001
84.	Parasitoid	<i>Euchalcis</i> sp.	<i>S. derogata</i>		Nair, 1975
85.	Parasitoid	<i>Eucomys lecaniorum</i> Meyr	<i>S. nigra</i> , <i>P. maxima</i>		Pruthi and Mani, 1940; Nair, 1975
86.	Parasitoid	<i>Oncochalcis rufescens</i> Cameron	<i>S. derogata</i>		Nair, 1975
87.	Parasitoid iv) Elasmidae	<i>Scutellista cynea</i> Mots	<i>S. nigra</i> , <i>P. maxima</i>		Ayyar, 1930; Nair, 1975
88.	Larval parasitoid	<i>Elasmus johnstoni</i> Ferriere	<i>Earias</i> spp., <i>P. gossypiella</i>	Tamil Nadu, North India	Cherian and Kylasam, 1941; Nair, 1975; Sekhon and Verma, 1983
89.	Larval parasitoid	<i>Elasmus indicus</i> Rohw.	<i>S. derogata</i>		Nair, 1975
90.	Larval parasitoid	<i>Elasmus philippinensis</i> Ashm	<i>S. derogata</i> , <i>P. gossypiella</i>		Nair, 1975; Nimbalkar, 2007
91.	Larval parasitoid	<i>Elasmus playedrae</i> Ferriere	<i>Earias</i> sp., <i>P. gossypiella</i>		Nair, 1975; Nimbalkar, 2007
92.	Larval parasitoid v) Encyrtidae	<i>Elasmus</i> sp.	<i>P. gossypiella</i>		Thompson, 1946
93.	Parasitoid	<i>Acerophagus papayae</i> Noyes & Schauff	<i>Paracoccus marginatus</i>	Central and South India	Nisha and Kennedy, 2017
94.	Parasitoid	<i>Aenasius advena</i> Camp.	<i>F. virgata</i>	Central India	Nair, 1975
95.	Parasitoid	<i>Aenasius arizonensis</i> (=bambawalei) Girault	<i>P. solenopsis</i>	All India	Hyat, 2009; Jhala et al., 2009; Ram et al., 2009; Fand et al., 2011; Nagrare et al., 2011
96.	Parasitoid	<i>Anagyrus chrysos</i> Noyes & Hayat	Mealybugs	All three zones	Gupta and Poorani, 2008

(contd.)

97.	Parasitoid	<i>Anagyris dactylopii</i> (Howard)	<i>P. solenopsis</i> & <i>M. hirsutus</i>	Karnataka, Tamil Nadu Karnataka	Pillai et al., 2009; Nalini and Manickavasagam, 2011
98.	Parasitoid	<i>Anagyris loecki</i> Noyes & Menezes	<i>P. madeirensis</i>	Karnataka	Shylesha and Joshi, 2012
99.	Parasitoid	<i>Anagyris qadrii</i> (Hayat, Alam & Agarwal)	<i>P. madeirensis</i>	Karnataka	Shylesha and Joshi, 2012
100.	Parasitoid	<i>Anagyris kamali</i> Moursi	<i>M. hirsutus</i> , <i>P. solenopsis</i>	Tamil Nadu	Nalini and Manickavasagam, 2011
101.	Parasitoid	<i>Anagyris mirzai</i> Agarwal & Alam	<i>P. solenopsis</i>	Tamil Nadu	Nalini and Manickavasagam, 2011
102.	Parasitoid	<i>Anagyris</i> sp.	<i>F. virgata</i>	central zone	Nair, 1975
103.	Parasitoid	<i>Anastatus</i> sp.	<i>P. solenopsis</i>	North India	Suroshe et al., 2013
104.	Parasitoid	<i>Anicetus ceylonensis</i> How	<i>Pulvinia maxima</i> , <i>S. nigra</i>	North India	Pruthi and Mani, 1940; Dastur, 1960
105.	Parasitoid	<i>Aphanogmus</i> sp.	<i>P. solenopsis</i>	North India	Suroshe et al., 2013
106.	Parasitoid	<i>Aphycus</i> sp.	<i>Pulvinia maxima</i>	North India	Dastur, 1960
107.	Parasitoid	<i>Encyrtus aurantii</i> (Geoffroy)	<i>P. solenopsis</i> , <i>M. hirsutus</i>	New Dehli	Vennila et al., 2010
108.	Parasitoid	<i>Encyrtus flavus</i> How	<i>Pulvinia maxima</i>	New Dehli	Dastur, 1960
109.	Parasitoid	<i>Encyrtus kotinski</i> Full	<i>S. nigra</i>	North India	Pruthi and Mani, 1940
110.	Parasitoid	<i>Encyrtus lecaniorum</i> Meyr	<i>S. nigra</i>	North India	Thompson, 1950
111.	Parasitoid	<i>Encyrtus barbatus</i> Timb	<i>S. nigra</i>	North India	Pruthi and Mani, 1940
112.	Parasitoid	<i>Homalotylus albiclavatus</i> (Agarwal)	<i>P. solenopsis</i> , <i>M. hirsutus</i>	Tamil Nadu	Nalini and Manickavasagam, 2011
113.	Parasitoid	<i>Homalotylus eytelweinii</i> Ratzeburg	<i>Cheilomenes sexmaculata</i>	Tamil Nadu	Nalini and Manickavasagam, 2011; Sankar et al., 2011
114.	Parasitoid	<i>Homalotylus indicus</i> (Agarwal): Hayat, Alam & Agarwal	Mealybugs	All 3 zones	Gupta and Poorani, 2008
115.	Parasitoid	<i>Leptomastix nigrocoxalis</i> Compere	<i>P. solenopsis</i>	South Zone	Bharathi and Muthukrishnan, 2017
116.	Hyperparasitoid	<i>Marietta leopardina</i> Motschulsky	<i>A. bambawalei</i> parasitizing <i>P. solenopsis</i>	Haryana	Ram and Saini, 2010
117.	Parasitoid	<i>Metaphycus</i> sp.	Mealybug <i>P. solenopsis</i>	Central India	Nagrare et al., 2011
118.	Egg parasitoid	<i>Ooencyrtus</i> spp.	<i>S. gossypii</i>	Central and South Zone	Nair, 1975
119.	Hyperparasitoid	<i>Prochiloneurus aegyptiacus</i> (Mercet)	On <i>Anagyris dactylopii</i> parasitizing <i>M. hirsutus</i> , <i>N. viridis</i> , <i>P. solenopsis</i>	Central and South Zone	Pillai et al., 2009; Nagrare et al., 2014b
120.	Parasitoid	<i>Prochiloneurus albifimiculus</i> (Hayat et al.)	primary parasitoids of mealybugs	Central india	Ram and Saini, 2010; Nagrare et al., 2014b
121.	Parasitoid	<i>Prochiloneurus pulchellus</i> Silvestri	<i>P. solenopsis</i> , <i>Nipaeococcus</i> spp, <i>Coccidohystrix insolita</i> (Green), etc	Central india	Nagrare et al., 2014
122.	Hyperparasitoid	<i>Prochiloneurus testaceus</i> (Agarwal)	On <i>Anagyris dactylopii</i> parasitizing <i>M. hirsutus</i> , <i>N. viridis</i> , <i>P. solenopsis</i>	Central and South Zone	Pillai et al., 2009

(contd.)

	<i>Pseudoleptomastix mexicana</i>	<i>Paracoccus marginatus</i>	Central India	Nagrare et al., 2015
123. Parasitoid vi) Eulophidae				
124. Parasitoid	<i>Aprostocetus bangaloreicus</i> Narendran	<i>P. solenopsis</i> & <i>M. hirsutus</i> in Central India	North India	Vennila et al., 2010
125. Parasitoid	<i>Euderus M.</i>	<i>P. affinis</i>	South India	Ayyar, 1941
126. Parasitoid	<i>Euderus gossypii</i> Ferrière	<i>S. gossypii</i>	South India	Nair, 1975
127. Parasitoid	<i>Eupelmella pedatoria</i> Ferr.	<i>P. affinis</i>	South India	Ayyar, 1941
128. Parasitoid	<i>Eupelmus</i> sp.	<i>P. affinis</i>	South India	Ayyar, 1941
129. Parasitoid	<i>Eupelmus urozonus</i> Dalm.	<i>P. affinis</i>	South India	Ayyar, 1941
130. Parasitoid	<i>Euplectrus ceylonensis</i> Howard	<i>E. fraterna</i>		Nair, 1975
131. Parasitoid	<i>Thripoctenus brui</i> Vuillet	<i>Thrips</i>		Dastur et al., 1960
132. Parasitoid	<i>Trichospilus pupivora</i> Ferr.	<i>S. derogata</i>		Nair, 1975
vii) Eurytomidae				
133. Hyperparasitoid	<i>Eurytoma braconidis</i> Ferrière	<i>B. greeni</i>	North India	Sekhon and Verma, 1983
viii) Ichneumonidae				
134. Larval parasitoid	<i>Campoletis chloridae</i> Uchida	Larval parasitoid of <i>H. armigera</i> & <i>S. litura</i>	Central India	Nimbalkar, 2007; Vennila et al., 2007
135. Larval parasitoid	<i>Enicospilus atricornis</i> Morl.	<i>S. derogata</i>		Nair, 1975
136. Larval parasitoid	<i>Enicospilus biconatus</i> Townes	<i>H. armigera</i>		Nimbalkar, 2007
137. Larval parasitoid	<i>Enicospilus merdarius</i> grav.	<i>E. fraterna</i>		Nair, 1975
138. Larval parasitoid	<i>Enicospilus</i> sp.	<i>E. fraterna</i>		Nair, 1975
139. Larval parasitoid	<i>Eriborus argenteopilosus</i> (Cameron)	Semilooper & <i>H. armigera</i>	Central India	Krishnamoorthy and Mani, 1989
140. Larval parasitoid	<i>Eriborus pilosellus</i> Cam	<i>H. armigera</i>		Nimbalkar, 2007
141. Pupal parasitoid	<i>Goryphus nursei</i> Cam.	<i>E. vittela</i> , <i>S. derogata</i>	Punjab	Nair, 1975; Jagmohan, 2001; Basarkar and Nikam, 2013
142. Ectoparasite	<i>Melich nursei</i> Cam.	Pupa	All India	Dastur et al., 1960
143. Ectoparasite	<i>Mesochorus</i> sp	<i>S. derogata</i>	Odisha	Mohapatra, 2004
144. Larval parasitoid	<i>Neopimploides syleptae</i> Viereck	<i>S. derogata</i>		Nair, 1975
145. Larval parasitoid	<i>Scambus lineipes</i> (Morley)	<i>P. gossypiiella</i> , <i>H. armigera</i>		Gupta and Tikar, 1967; Nimbalkar, 2007
146. Larval parasitoid	<i>Scambus stratus</i> Gupta & Tiker	<i>P. gossypiiella</i>		Nimbalkar, 2007
147. Pupal parasitoid	<i>Xanthopimpla punctata</i> (F.)	<i>S. derogata</i>		Nair, 1975
ix) Mymaridae				
148. Egg parasitoid	<i>Erythmelus empoascaae</i> Subba Rao	<i>A. biguttula</i> <i>biguttula</i> , <i>E. vittela</i>	North India	Subba Rao, 1966
149. Egg parasitoid	<i>Gonatocerus</i> sp.	<i>E. vittela</i>		Vennila, 2007
x) Pteromalidae				
150. Parasitoid	<i>Aplatomorpha calandree</i> How.	<i>P. affinis</i>	South India	Ayyar, 1941
151. Parasitoid	<i>Anisopteromalus calandrae</i> (Howard)	<i>S. gossypii</i>		Nair, 1975

[=Neocatolaccus indicus R &amp; M.]

(contd.)

152.	Parasitoid xi) Scelionidae	<i>Pachyneuron leucopiscicida</i> Mani	<i>M. hirsutus</i>	Central India	Nagrare et al., 2014b
153.	Egg parasitoid	<i>Telenomus remus</i> Nixon	<i>E. vitella</i> , <i>S. derogata</i>	North India	Nimbalkar, 2007
154.	Egg parasitoid	<i>Aholcus euproctiscidis</i> Mani	<i>E. fraterna</i>		Narayanan et al., 1959; Nair, 1975
155.	Parasitoid xii) Thysanidae	<i>Chartocerus kerrichi</i> (Agarwal)	<i>M. hirsutus</i>	Central India	Vennila et al., 2010
156.	Parasitoid xiii) Trichogrammatidae	<i>Trichogramma pretiosum</i> (= <i>brasiliensis</i> ) Riley	Lepidoterous pests	North India	Sundarmurthy and Chitra, 1992; Nimbalkar, 2007; Naik et al., 2019
157.	Egg parasitoid	<i>Trichogramma achaea</i> Nagaraja & Nagarkatti	<i>Earias</i> spp. <i>P. gossypiella</i>	Punjab Uttarakhand	Sekhon and Varma 1983; Yousuf et al., 2015
158.	Egg parasitoid	<i>Trichogramma bactrae</i> Nagaraja	<i>P. gossypiella</i>	Central India	Naik et al., 2019
159.	Egg parasitoid	<i>Trichogramma chilonis</i> Ishida	Lepidoterous pests	North India, Odisha	Sekhon and Verma, 1983; Brar et al., 2002; Mohapatra, 2004
160.	Egg parasitoid	<i>Trichogramma chiloiraee</i> Nagaraja & Nagarkatti	Lepidoterous pests		Nimbalkar, 2007; Yousuf et al., 2015
161.	Egg parasitoid	<i>Trichogramma evanescens</i> West.	Lepidoterous pests	All three zones	Dastur et al., 1960
162.	Egg parasitoid	<i>Trichogramma minutum</i> Riley	<i>A. flava</i>		Nair, 1975
163.	Egg parasitoid	<i>Trichogrammatoidea</i> sp near <i>guamensis</i> Nagaraja	<i>Earias</i> spp., <i>P. gossypiella</i>	North India	Varma, 1979; Sekhon and Verma, 1983
<b>Order: Diptera</b>					
164.	Family i) Chloropidae				
165.	Larval parasitoid	<i>Polydaspis</i> sp	<i>Earias</i> spp.		Nair, 1975
165.	Larval parasitoid	<i>Actia aegyptia</i> Vill.	<i>E. vitella</i>	North & Central zone	Dastur et al., 1960
166.	Larval parasitoid	<i>Actia hyalinata</i> Mall.	<i>E. vitella</i>	South zone	Cherian and Kylasam, 1941
167.	Larval parasitoid	<i>Actia monticola</i> Mall.	<i>A. flava</i> , <i>T. notabilis</i>		Nair, 1975
168.	Larval parasitoid	<i>Afrovena indica</i> Mensil	<i>P. gossypiella</i>		Nimbalkar, 2007
169.	Larval parasitoid	<i>Bessa remota</i> (Aldrich)	<i>S. derogata</i>		Nair, 1975
170.	Larval parasitoid	<i>Carelia raoi</i> Mensil	<i>H. armigera</i>		Nimbalkar, 2007
171.	Larval parasitoid	<i>Carelia</i> sp.	<i>H. armigera</i>		Nimbalkar, 2007
172.	Larval parasitoid	<i>Carelia kockiana</i> Townsend	<i>A. flava</i> , <i>H. armigera</i>		Nair, 1975; Nimbalkar, 2007
173.	Larval parasitoid	<i>Drino</i> sp nr <i>unisetosa</i> Bar	<i>H. armigera</i>		Nimbalkar, 2007
174.	Larval parasitoid	<i>Eucarcilia illota</i> Curran	<i>Anomis flava</i> & <i>H. armigera</i>	North zone	Mohan et al., 2014
175.	Larval parasitoid	<i>Eucelatoria bryani</i> Sabrosky	<i>H. armigera</i>		Sundaramurthy and Chitra, 1992
176.	Larval parasitoid	<i>Exorista apicalis</i> Bar	<i>A. flava</i>		Nair, 1975
177.	Larval parasitoid	<i>Exorista fallax</i> Mg	<i>H. armigera</i>		Nimbalkar, 2007
178.	Larval parasitoid	<i>Exorista japonica</i> Tns	<i>H. armigera</i>		Nimbalkar, 2007
179.	Larval parasitoid	<i>Exorista siviloides</i> Bar.	<i>T. notabilis</i>		Nair, 1975
180.	Uji fly	<i>Exorista sorbillans</i> Wiedemann	<i>T. notabilis</i>		Nair, 1975

(contd.)



(contd. Table 3)

181.	Larval-pupal parasitoid	<i>Gontophthalmus halli</i> Meshii	<i>H. armigera</i>	Nimbalkar, 2007
182.	Larval parasitoid	<i>Isomera cinerascens</i> Rondani	<i>H. armigera</i>	Nimbalkar, 2007
183.	Larval parasitoid	<i>Palxorista laxa</i> (Curran)	Lepidopteran insects	Sundaramurthy and Chitra, 1992
184.	Larval parasitoid	<i>Sisyropa apicata</i> Baranov	<i>H. armigera</i>	Nimbalkar, 2007
185.	Larval parasitoid	<i>Strobliomyia aegyptia</i> Villeuve	<i>H. armigera</i>	Nimbalkar, 2007
186.	Larval parasitoid	<i>Strobliomyia nana</i> (Curr.)	<i>Earias</i> spp.	Nair, 1975; Rao and Mahadeva, 1964
187.	Larval parasitoid	<i>Strobliomyia plebeia</i> (Mall.)	<i>Earias</i> spp.	Nair, 1975
188.	Larval parasitoid	<i>Sturmia inconspicuooides</i> Baranov	<i>A. moorei</i>	Nair, 1975
189.	Larval parasitoid	<i>Sturmia macrophallus</i> Baranov	<i>A. flava</i>	Nair, 1975
190.	Larval parasitoid	<i>Thecocarcelia incedens</i> Rondani	<i>H. armigera</i>	Nimbalkar, 2007
191.	Larval parasitoid	<i>Voria edentata</i> Baranov	<i>H. armigera</i>	Nimbalkar, 2007
192.	Larval parasitoid	<i>Voria ruralis</i> Baranov	<i>H. armigera</i>	Nimbalkar, 2007
193.	Larval parasitoid	<i>Winthemia</i> sp. prob nr <i>diversoides</i> Baranov	<i>H. armigera</i>	Nimbalkar, 2007
<b>Order: Acarina</b>				
Family: Pyemotidae				
194.	European straw itch mites	<i>Pyemotes ventricosus</i> (Newport)	<i>P. gossypiella</i>	Sundaramurthy and Chitra, 1992